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ABSTRACT

This guide provides a framework to help think about, choose, create, and design an electronically networked community. It is written for educators and educational entities involved with the design and implementation of educational projects. The guide will help planners and designers decide what type of networked community to create; what factors to consider in selecting an electronic network to support the community; what networks or network projects already exist to provide resources to meet the needs of the community; and how members could gain access to the network. Chapter 1 introduces some basic concepts about networked communities and relates these concepts to education. Chapter 2 identifies criteria for selecting a network, beginning with its educational purpose and concluding with connection considerations. Chapter 3 describes types of networks, characterized by factors and issues relevant to decision making. Chapter 4 presents examples of networked communities in terms of the frameworks and factors defined in the preceding chapter. Included in the appendices are descriptions of networks and/or projects mentioned; comments on the future of networking in the schools; and a glossary. (Contains 28 references.) (JLB)

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An Educator's Guide To Electronic Networking: Creating Virtual Communities

Barbara L. Kurshan
Marcia A. Harrington
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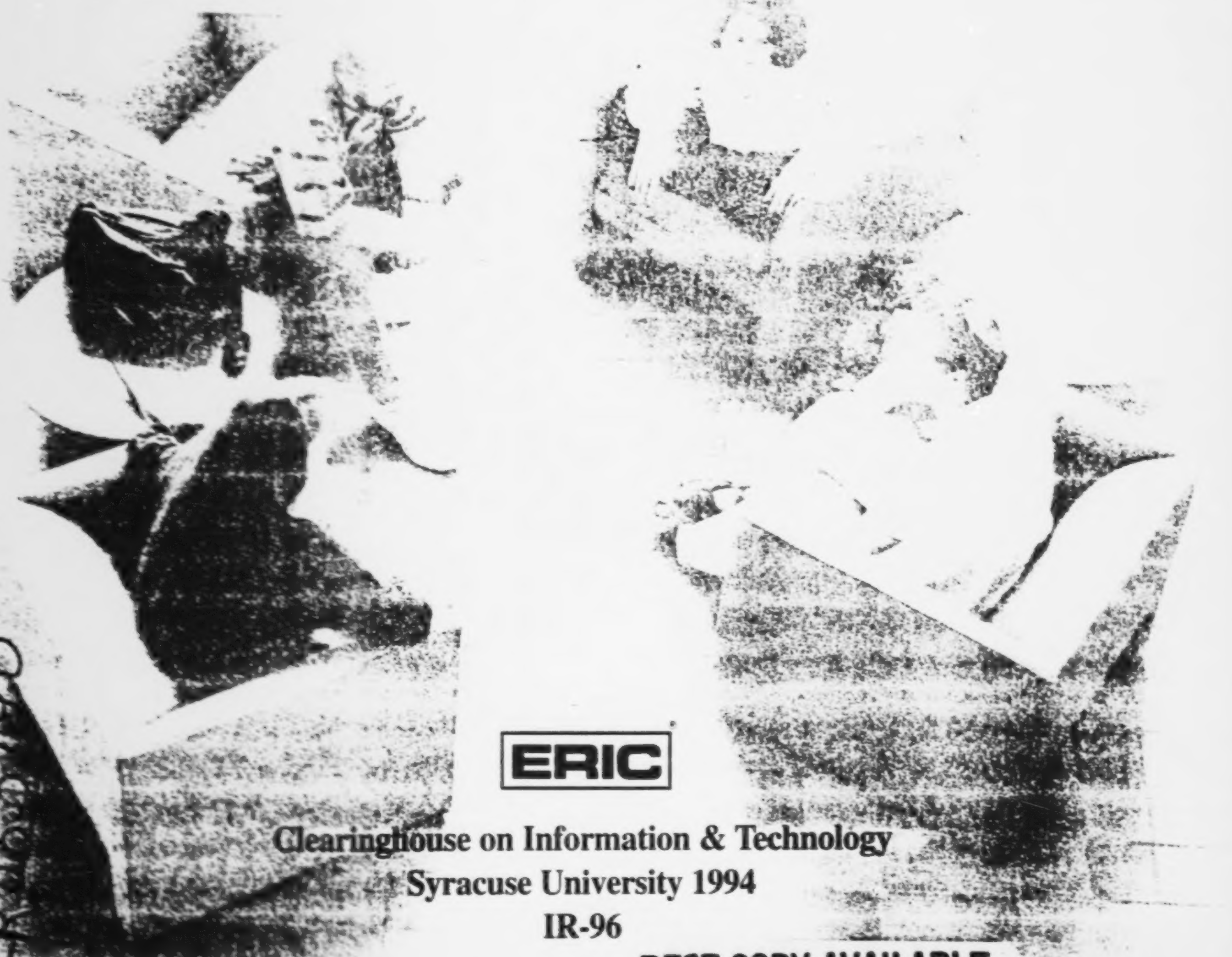

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An Educator's Guide to Electronic Networking: Creating Virtual Communities

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This edition was revised and updated in December 1993 by Peter G. Milbury, Co-owner/founder of LM_NET: The School Library Media Discussion Group and Library Media Teacher, Pleasant Valley High School, Chico, CA.

Introduction

One definition of a community is "a group that is linked for the purpose of achieving shared goals." Each of us belongs to several communities through our recreational, social, and professional affiliations. We join these communities because of expectations of shared knowledge and personal fulfillment.

In the educational environment, through the use of local, regional, national and international computer networks, "electronic" or "virtual" communities have formed, and will continue to form for a variety of purposes:

- A group of fifth and sixth grade teachers communicates daily through their computers about a cooperative science project.
- A tenth grade class in Scottsdale, Arizona sends **data*** to a supercomputer in California.
- A school superintendent in Rome, New York sends a memo to all of the school superintendents in the state, soliciting feedback on a referendum before the legislature.
- A group of educators meets **online** (electronically, on computers) to establish a consortium to develop networking **standards for educational telecommunications** through online exchanges of information.

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*Words in boldface have specific meanings in computer and telecommunications technology. These words are defined in the glossary in Appendix C and, if it does not interrupt the flow of the narrative, they are explained the first time that they are used.

Each of these scenarios presents an example of an electronically networked community. An electronically networked community is one bound by common use or purpose rather than by physical location, technological orientation, institutional affiliation, grade level, or subject area. Its members communicate electronically by means of computer-based networks. A **network** is a collection of computers connected to each other through communications links--either local or distant.

Electronically linked communities have potentially more equitable access to the resources of expertise, information, and tools (such as computer **programs** and **databases**.) These resources may be available throughout their campus, their school district, the country, and the world. Through the use of a computer network, distance is a factor that is negated.

Computer networks provide easy, inexpensive access to many resources that are not readily attainable by other means. Electronically networked communities can have local, regional, national, or international participants who can enter the network whenever or wherever it is convenient for them to do so.

This guide, *An Educator's Guide to Electronic Networking: Creating Virtual Communities*, provides a framework to help think about, choose, create, and design an electronically networked community. It is written for educators and educational entities--individuals and organizations representing elementary and secondary school teachers and administrators, educational leadership groups, school boards, institutions of higher education, museums, departments of education, and others involved with the design and implementation of educational projects. In particular, the *Guide* will help planners and designers to answer four basic questions:

1. What type of networked community do I want to create?
2. What factors do I need to consider in selecting an electronic network to support this community?
3. What networks or network projects exist already that provide the best resources to meet the community's needs?
4. How can the members of the community gain access to the network?

The first question seeks to match educational goals and objectives with the features of electronic networks. The second question addresses factors that require careful analysis during the process of selecting and creating a network. The third links the attributes of networks or network projects with the educational community's objectives. The last question explores how members of a group can become participants in a network.

Chapter 1--introduces some basic concepts about networked communities and relates these concepts to education.

Chapter 2--identifies criteria for selecting a network, beginning with its educational purpose and concluding with connection considerations.

Chapter 3--describes "Frameworks," or types of networks, characterized by factors and issues relevant to decision-making.

Chapter 4--presents examples of networked communities in terms of the frameworks and factors defined in Chapter 3.

The framework format is extended to future technologies in the Concluding Remarks.

The appendices contain descriptions of networks and/or projects mentioned in the *Guide* (Appendix A), comments on the future of networking in the schools (Appendix B), a glossary (Appendix C), and resources and references (Appendix D).

Table 1
Exploring the *Educator's Guide to Electronic Networking*

	Studying the process	**Understanding the frameworks**	**Reviewing existing networks**
Primary purpose and/or perspective of the user	To identify and learn a process for creating a networked community	To determine the types of electronic networks available and to relate them to the community's purpose	To review current networks and projects in order to create a community and select an electronic network
Order in which to read chapters	Chapters 1-4	Chapters 3-4 Chapters 1-2	Chapter 4 Chapters 1-3

There are several ways to use the information in this guide. Some readers may prefer to read about some of the existing networks first, before studying the selection process for creating a networked community. Others may want to understand the frameworks of electronic networks before analyzing the decision-making process. Table 1 suggests three ways in which readers can approach the information presented herein.

Change Is Continual

Computer-based networking is changing rapidly and will continue to change during the next decade. This guide offers a decision-making procedure and frameworks of models to help educators select or design an electronically networked educational community. The same procedure will be applicable to future frameworks as they evolve with new technologies such as video networks, fiber networks, and satellite-based networks.

A Note on the Language of Computer Networking and Telecommunications

Each field or profession has its own language. The world of computers and information technologies is no exception. The reader may encounter new expressions or familiar words with unfamiliar meanings. It is necessary to understand at least some of the specialized vocabulary used by computer telecommunications professionals in order to be able to communicate with them and to know what is meant when certain phrases or words are used. Therefore, when we have included some of these essential technical terms, they are printed in boldface, defined in the glossary in Appendix C, and, in some instances, explained the first time that they are used.

Chapter 1

Networked Communities

The Impact of Information and Computer Communication Technologies on Community Structure

Information and computer communication technologies, such as computer networking, **electronic mail (e-mail)**, video, and fax machines, are common means of communication today. These technologies have changed quickly the ways in which we live and work, largely by changing the ways in which we communicate and the number of people with whom we can communicate. Information and computer communication technologies offer us access to new communities--electronic, "virtual" communities that we might not join without these new technologies.

Throughout most of our history, classroom communities have consisted of a teacher and students. In those communities, the teacher and the students have interacted directly by talking and writing to each other, usually while in visual proximity.

In the classroom community of today, the ways in which we communicate and converse have changed dramatically. These changes are relevant to the evolution of networked communities. This is because of how the members communicate and how the technology they communicate with affects the structure of the community directly. This evolution is illustrated in four instructional conversations described by Ehrmann (1990). His conversational models demonstrate that the ways in which information is presented by teachers have altered immensely, partly because of developments in information and computer communication technologies.

Ehrmann explains the roles that technology can play in education by outlining four types of conversation in which students engage as they learn. He shows how these conversations are made possible with both the traditional technologies, and with the new information and computer-based communications technologies. Ehrmann argues that the best and most flexible instruction takes place when all four models of conversation happen easily. Clearly, the educational setting dictates the type of conversation as well as the technology employed. The conversational models are:

- Direct Instruction
- Real-Time Conversation
- Time-Delayed Conversation
- Learn by Doing

These conversational models are described below, both in the context of traditional presentation methods and in methods made possible by the new information and computer communications technologies.

Direct Instruction

Direct instruction technologies, such as overhead projectors and textbooks, have traditionally supported a teacher's conversation in the classroom or lecture hall. On the other side of the conversation, a student might ask silently, "What did the teacher mean just then?" and, often, received no reply. Today, direct instruction is supplemented or replaced by live or taped video, computer-based instruction, e-mail, and videodiscs in order to give students a greater variety and volume of information.

Real-Time Conversation

Real-time conversation was traditionally conducted using a blackboard or a seminar table. Today, it is carried on by telephone, audio/video conferencing, and two-way video. A networked community that participates in the development of instructional materials is an example of those who would use this mode of conversation.

Time-Delayed Conversation

Time-delayed conversation formerly involved the exchange of papers in the classroom. Today, this method of conversation is accomplished using information and computer communication technologies like fax machines, **file transfer** features, computer conferencing, and **shared text**. Time-delayed conversations take place in electronically networked communities whose purposes are to support professional collaborations, cooperative investigations among students and distant classrooms, and also in the professional development of teachers.

Learn by Doing

Learn by doing used to be achieved using typewriters, slide rules, libraries, laboratories, and internships. Today, word processors, statistical **software**, online libraries, listserv discussion groups, **databases**, and simulations extend students' reach and provide new means by which they learn by doing a task. Electronically networked communities that can **access** supercomputers, or enter, access, and retrieve information from remote sites, are further examples.

As we can see from Ehrmann's conversations, technology has already had a significant impact on the traditional ways of conversing in the classroom. The new technological innovations in computer communications have also paved the way for new communities and collaborations to develop. While the basic modes of conversation have remained the same, the means by which they are carried on have not. Today, electronically networked communities employ all of these modes of conversation with varying degrees of technological sophistication, through the appropriate use of computer communications technology.

Information and Computer Communication Technologies: Means of Accomplishing Educational Objectives

Innovations in information and computer telecommunications technology have made electronically networked communities a viable way of supporting learning, teaching, research, and professional development. Indeed, electronically networked communities that meet a variety of educational goals and needs are already thriving. Communities have been formed to support the professional development and instructional needs of educators, to facilitate access to resources, and to provide instructional services.

Some networked communities support professional collaborations, students' investigations, collaborative development and electronic delivery of instructional materials, as well as continuing education and professional development for teachers.

Electronically networked communities also facilitate access to information resources. For example, some networks are designed specifically to provide access to scientific expertise (connecting both individuals and databases), information for students and teachers, not to mention the linking of **hardware** and software resources. Additionally, **online courses** (classes on the computer that students can learn at their convenience) with support and development services for the networked community are available through electronically networked communities.

These communities offer opportunities for growth, development, and collaboration to educators, students, parents, and researchers. Table 2 relates traditional and electronic modes of delivering information for the purpose of the networked community. Examples of electronic networks and projects (or categories of projects) that illustrate and fulfill the purpose of the networked community are listed in the last column. These networks and projects are described in Chapter 4 or Appendix A. The electronic modes and categories are defined in the glossary (Appendix C).

Meeting Educational Challenges with Electronically Networked Communities through Computer Telecommunications

Electronic networks through computer telecommunications have the potential to make possible more equitable access to educational resources and opportunities across disparate places of learning and teaching in this country and around the world. Educational communities employ networks for two central purposes.

The first central purpose is to promote collaborative efforts. By design, networked communities provide opportunities for professionals, educators, researchers, and business and industry leaders to collaborate. These electronically networked communities can support professional development, collaborative learning, and the reform and restructuring challenges facing education. Carefully designed and managed networked communities can make it possible for students and teachers to have closer relationships with experts outside

Table 2
Information Delivery in Networked Communities

Purpose of the networked community	Traditional delivery modes	Electronic delivery modes	Representative electronic networks & projects
Professional collaboration among teachers	Exchange papers, seminars, phone conversations	File transfer, online conferences, databases	FrEdMail, state networks
Students' group investigation	Projects, libraries, seminars	File transfer, online conferences, databases	NGS Kids Network, AT&T Learning Network
Access to experts	Phone, mail, lectures	E-mail, video and audio conferences	Tele-Apprenticeships
Access to information	Libraries, exchange papers	File transfer, online resources, remote access, databases, bulletin boards	DIALOG's Classmate, IGC databases
Access to computing resources	Laboratories, internships, simple equipment, such as slide rules and calculators	Remote access, databases, indexes, supercomputers, shared programs	Big Sky, Telegraph, SuperQuest
Team development among students (electronic publishing)	Seminars, journals, and other printed materials	File transfer, online conferences and courses, curricular resources	WorldClassroom; electronic journals, e.g., *Newslink*
Teachers' professional development	In-service training courses, blackboards, handouts	Online conferences and courses, bulletin boards, shared text	Teacher Link, ENAN, IBM's PSInet
Online courses	Lectures, classroom presentations, handouts	Video and audio conferences, shared text, bulletin boards, online courses	ISTE online courses, America Online courses
Support for networked community	Professional organizations, mail, pamphlets, training	E-mail, shared text, bulletin boards, online courses	CoSN, listservs, e.g., KIDSPHERE, LM_NET, K12ADMIN

their school, whether those experts be scientists in an industry laboratory, other teachers and students collaborating in similar projects, faculty at a university, educators in a science museum, or political leaders at the state legislature.

The second central purpose of networks is to provide access to information and tools, such as libraries, databases, curricular materials, tests, computer programs, instruments, and supercomputers. Networks are able to promote and encourage a variety of research goals, constructive learning, and the development of problem-solving skills.

While technological support for learning is, in many respects, still in its infancy, it is steadily and rapidly evolving. Yet what is even now being experienced is encouraging. Successful collaborations have occurred at all levels. Elementary school classes are working with educational professionals to improve curricula. High school students are participating in scientific investigations using remote supercomputers. Teachers are trying out new instructional methods through joint activities with their peers and other professional educators.

Thus, electronically networked communities hold promise as one of the means of meeting some of the challenges that face the educational system. These challenges can be divided into two categories: community and infrastructure. Community tasks refer to efforts that support the pedagogical environment. Infrastructure tasks include efforts that support the physical and technological development of networks. Many of the following educational challenges fall into both categories:

- Supporting a shift toward collaborative learning
- Supporting constructive learning
- Developing problem-solving and scientific inquiry skills
- Promoting scientific research and maintaining databases
- Encouraging research by teachers
- Meeting the educational needs of multicultural populations
- Improving the assessment of what students have learned
- Reforming and restructuring education
- Increasing learners' access to experts
- Linking schools, homes, community organizations, and businesses

The ways in which the networked community is organized and managed will affect both its effectiveness and the kinds of network resources needed. Aspects to consider (e.g., see Riel, 1989) include:

- Organization of the networked group(s): size, common knowledge, interests, past experiences, and the physical and institutional locations of the participants.
- Organization of the task(s): the types of activities that the participants will engage in over the network and how they intend to accomplish their objectives.
- Response obligations and opportunities: ease of access to the interaction, including the social and technical resources for sending and receiving **messages**, and the tacit or formal requirements for responding to a message.
- Coordination and support: the structures for facilitating group interaction, support for the technical and curricular development of the network, and means of assessing the quantity or quality of the exchanges on the network.

Technology has been a driving force behind the evolution of how conversation and communication are carried out in and beyond the classroom. Direct verbal conversation is no longer the sole mode of communication available to educators to teach their students. Electronically networked communities have proved to be a means by which educators can meet many of today's educational challenges successfully. While networked communities offer a strong tool for educators to meet the above challenges, of greater importance will be learning how to tap the potential of these networked communities to achieve creative solutions through educational telecommunications.

The Concept of Internetworking

The relatively new technology of internetworking (see Hunter, 1992) makes it possible to interconnect many disparate networks and make them function as a coordinated unit. The internetworking technology includes a set of network standards that specify the details of how computers communicate as well as a set of conventions for interconnecting networks and routing traffic. The result of implementing these standards on a very wide basis is the Internet, which has worldwide connections and is discussed in the next section.

The Global Internet

The Internet is growing so rapidly that it is hard to monitor its size, but a recent estimate stated that in October 1993 it included 2,056,000 computers worldwide. (Of these 636,919 were addressed to educational sites; 119,454 to governmental sites; and 516,880 commercial sites, in the U.S.) Part of the reason for this very rapid growth is the fact that Internet standards are published openly and can be applied to new hardware and software **platforms** as they become available. A very important characteristic of internetworking from the point of view of elementary and secondary schools is that it allows diverse makes and models of computers to communicate with each other. Thus, in the internetworked environment, schools can use many of the machines that they already have. Equally important, they are not restricted to the **processing** power of the machines physically installed in the school because they can access more powerful machines on the networks with which they are able to connect.

In terms of scope, the set of Internet protocols or operating standards, is the evolving standard for communication among electronic networks. Its global network infrastructure reaches nearly every country in the world. Because of its worldwide scope and the collective makeup of its participants, the Internet offers a wealth of opportunity for learners of all ages.

The Internet is the electronic means by which individuals at major research institutions collaborate, share data, and conduct research. This method of creating electronic communities has been used effectively in higher education for quite some time. But until very recently, it was inaccessible to learners and teachers in elementary and secondary schools or in homes.

The growth in the use of telecommunications in the K-12 classroom, and the increase in collaborations between institutions of higher education and other places of learning have paved the way for other networks to employ many of the Internet's features as well as to use the Internet as the foundation for their infrastructure and services. This growth will continue as long as schools make use of current and planned investments in local, district, and state education networks. One proposal for connecting to the Internet through existing infrastructures such as **local area networks** is described by Newman, Bernstein, and Reese (1992) in *Local Infrastructures for School Networking: Current Models and Prospects*. The summary of this report is reproduced in Appendix B.

The most commonly used services or features on the Internet are e-mail, file transfer, and **remote log-in** (the ability to connect to a remote computer by using an identifying name and a **password**). The resources available on the Internet include computing centers, online libraries, software, **mailing lists**, listservs, **archives**, data archives, and databases that support network uses and users. Lists of the files that can be accessed by the public are maintained on the Internet, along with **files** that help users to gain access to such Internet resources as stored files, listserv discussion groups and their archives, **host servers**, and **bulletin boards**.

The Internet was formed in 1983. Today, it is a worldwide collection of thousands of interconnected computer networks. Until recently many considered it a North American network because this was where most of its **hosts** (computers that store information and/or facilities for telecommunications) resided; however, the Internet's component parts extend to several continents, as may be seen by using a Gopher server to explore listings of accessible sites among the nations of the world.

One of the Internet's component parts in the U.S. is the **NSFNET**. NSFNET began providing **backbone** service (a backbone is a high-speed connection that links many networks) to the Internet in July 1986, to allow supercomputer centers to communicate. NSFNET's scope has expanded and it is now an effective, national, research network. As one of the backbones of the Internet, this infrastructure forms the National Science Foundation's international network. Originally, NSFNET linked research universities with each other and with NSF-supported supercomputers. The NSFNET backbone includes a number of midlevel (sometimes called regional) networks. These networks provide connections within regions of the United States and to the Internet. The midlevel networks also connect to universities and commercial agencies. These agencies are connected by high-speed, high-capacity lines throughout the country. Midlevel networks include BARRNet, CSUNet, JVNCNet, MERIT, MIDnet, NCSAnet, NorthWestNet, NYSERNet, PSCNet, SURAnet, THEnet, and WESTNET, whose full names and the areas they serve are listed below.

BARRNet: San Francisco Bay Area Regional Research Network

CSUNet: California State University Network, the Campuses of the State University System, plus dial-up nodes for California K-12 schools and other governmental organizations

JVNCNet: John von Neumann Supercomputer Center Consortium Research Network, Northeastern United States

MERIT: Academic Computer Network, Michigan

MIDnet: Midwest Research Network, Midwestern United States

NCSAnet: National Center for Supercomputing Applications Network

NorthWestNet: Northwestern States Research Network, Northwestern United States

NYSERNet: New York State Educational Research Network, New York and surrounding states

PSCNet: Pittsburgh Supercomputing research network, Eastern United States

SURAnet: Southeastern Universities Research Association Network, Southeastern United States

THEnet: Texas Higher Education Research Network, Texas

WESTNET: Mountain States Research Network, Mountain States of the United States

Chapter 2

The Selection Process

An electronically networked community can be defined in terms of its:

- Purposes
- Participants
- Functions and services
- Infrastructure

The purposes and participants give a networked community its identity. The functions and services refer to the computer-mediated means by which communications, interaction or the retrieval of information takes place. **Infrastructure** encompasses the technological attributes of the network such as the hardware and software that enable it to function.

A decision-making process for establishing a networked community can be defined in four steps.

1. Identify the educational purpose of the community.
2. Decide the level of network management needed.
3. Match the features of a network with an environment.
4. Assess connection issues.

The first step is to identify what is to be achieved by the community; that is, its educational purpose. For example, the directors of a curriculum development project may want to create a community of testing of new instructional materials. The purpose would be to facilitate close collaboration among all the members of the team, who are located in different schools and universities, to make it possible to distribute and get feedback on new versions of lesson materials. Thus, the educational purpose would determine the features needed on the network. Network features refer to the computer-mediated means (that is, conferencing, e-mail, **listservs**, or remote **log-in**) by which the group carries out its educational objective.

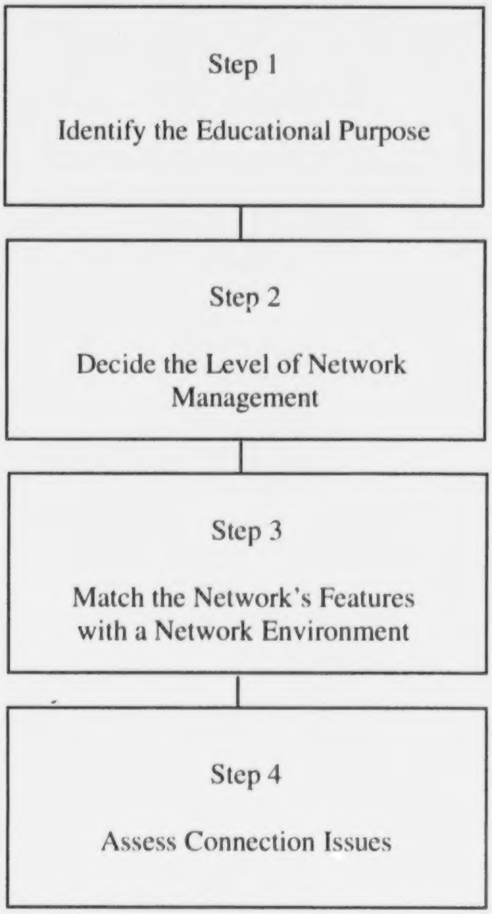
There may be more than one means that will enable the community to achieve its educational purpose. In a curriculum development project, for example, the group might begin with an electronic mail connection among all the members, merely to coordinate schedules and distribute brief messages. Then it might progress to a conferencing system, with several topics and subtopics in which various members participate. Next, a database might be created of the current versions of the project's materials, from which members can retrieve the modules or computer programs they want to use.

The second step is to decide the level of network management that the community needs. For example, should a moderator be chosen to routinely examine and approve of the messages before they are posted to the group (if a conferencing or listserv discussion format are used) to assure that it is within the guidelines? Other questions might relate to the determination of who is eligible to become a member of the group.

The third step involves matching the features of a network with a structure that will meet the educational purposes of the community. That is, the actual selection of an existing discussion group, conference or network, or the decision to establish a new one.

The final step deals with connection issues. For example, how are the members of the community to connect with each other (networks, **conferences**, bulletin boards, listserv discussion group, direct e-mail). Figure 1 illustrates the steps of the decision-making process.

Figure 1 The Selection Process


Step 1
Identify the Educational Purpose
Step 2
Decide the Level of Network Management
Step 3
Match the Network's Features with a Network Environment
Step 4
Assess Connection Issues

Step 1: Matching Educational Purpose with the Features of an Electronic Network

The process of identifying and creating a networked community depends upon its educational purpose. Promoting collaborative learning and improving student assessment are two examples of an educational purpose. Identifying the educational purpose also identifies the potential participants in a networked community.

Ideally, the educational purpose should determine the features needed in the network. In reality, financial concerns usually dictate the features chosen; however, cost depends upon a multitude of factors, which are addressed in Chapter 3. The cost of creating and sustaining an online community depends primarily on whether the majority of the intended participants have access to a computer-communications network already. In the present state of evolution of network infrastructure, this varies widely by type of institution and locality. The cost factors to be considered will be entirely different in various cases. For example, suppose a mathematics professor at a university wishes to facilitate a working group of high school teachers from Texas and Virginia to develop a set of lessons on fractals. Because the teachers in Virginia and Texas have access already to state networks with **gateways** to the **Internet**, and the professor accesses the Internet through her university, the group probably would set up a listserv. Lesson materials and fractals software could be exchanged among the participants by attaching these items as binary files to e-mail messages or obtained by **FTP** from the professor's machine. The only costs involved would be the time that the professor and the teachers spend on the effort. This *Guide* hopes to lead the decision-maker away from a selection process that is based exclusively on cost, and toward a decision that is based on present and future needs.

The educational purpose will turn the decision-maker toward the network features and functions that will best help the community to meets its goals. The features of the network determine how the **users** interact and how they access information. These features (which are explained below and in the glossary in Appendix C) include electronic mail, bulletin boards, listservs, **moderated conferences**, access to network or project databases, file functions, access to and searching in remote databases, and access to other remote resources such as supercomputers. If the educational purpose is to establish collaborative relationships with peers or to enable students to exchange information, electronic mail might be sufficient. However, if the educational purpose necessitates access to supercomputers for research or computation, the community will require more sophisticated features in its network.

The most common features of electronic networks are:

- **Electronic mail (e-mail)**--the transfer of messages from one individual on an open network to another. At present, such messages are typed, and may include attached graphics or visual files. In the future, they may be spoken or include video images as well.

- **Bulletin board systems (BBS)**--an electronic means of publicizing and locating information related to a specific topic. Members of the networked community can peruse the list of comments and responses posted on a bulletin board and respond, if they wish. A bulletin board can be moderated by its organizer or by someone appointed by the members of the group. This person functions in writing like a speaker presiding at a meeting or like a group facilitator.
- **Listservs**--a method for distributing messages electronically to a group of users who have a common interest. Listservs can be moderated too.
- **Conferences**--online, written discussions among groups formed around a specific area of interest. Participants type their statements and comments. Conferences usually have a moderator to facilitate and/or coordinate the discussion. Again, the moderator functions in writing like a speaker presiding at a panel meeting. Some conferences are conducted in **real time**, that is, with all participants communicating at the same time. Most conferences are conducted asynchronously, with the participants responding to each other within a day or a week.
- **Electronic network databases** or **Project-designed databases**--specialized databases that typically are established for a particular project or are available on a network for specific educational activities or uses.
- **File functions**--the access, retrieval, and transfer of files between computers. Executing these functions is often referred to as FTP (file transfer protocol). (Originally, FTP was the primary method of sharing files of **text** and software among colleagues around the U.S. and the world through **WANs** and the Internet. Recently, **network utilities** such as **WAIS** and **Gopher** have simplified the archival and retrieval of text files, leaving FTP as the retrieval mechanism of software files.)
- **Access to remote databases**--the feature that allows a user at one site to interact with a database at another site as if the user's terminal were connected directly to the **system** where the database is located. With this

feature, users can search and retrieve information from remote databases.

- **Access to remote supercomputers and other resources**--which enables users to gain access to the computing facilities of supercomputers and other hardware and software resources at major universities and non-academic research sites.

As noted earlier, the features desired for a network will depend upon the community's educational purpose. Table 3 gives examples of educational challenges, typical activities undertaken to tackle them, and technologies that can be employed to meet them.

Once the features and functions of a network have been decided, the prospective users need to consider how the network will be managed. The options are reviewed in the next section.

Table 3
Meeting Educational Challenges With Electronic Network Technologies

Challenge	Typical activities	Technologies
Promote collaborative learning	Joint problem solving, design collaborative noncompetitive projects	E-mail, conferences, network projects, two-way audio/video
Promote constructive learning	Interact with experts, "discovery" learning, design new curricula	E-mail, conferences, two-way audio/video
Develop problem solving skills	Meet with community leaders to solve problems, participate in research-based projects, solve problems with supercomputing resources	Information access and retrieval from libraries, databases, and supercomputers; e-mail, file transfer
Promote scientific research	Interact with experts, solve problems suggested by industry or community leaders	E-mail, conferences, listservs, supercomputing access
Meet multicultural needs	Exchange information for class projects; explore cultures through discussions, research, and exchanges; ensure equal access to networks	E-mail, listservs, online library access, databases
Improve assessment	Interact with other educators and researchers, develop assessment tools and portfolios	E-mail, conferences, bulletin boards, file transfer
Reform and restructure education	Interact with educators, researchers, government officials, community leaders, and parents	E-mail, conferences, listservs, bulletin boards, file transfer

Step 2: Managing a Networked Community

Managing a networked community entails facilitating the flow of information to and between the users of an electronic network. It also involves the technical maintenance of the network. The amount of intervention or management varies from one community to another.

This step in the selection process involves determining the kind of management that will be necessary for the network and its community of users to function effectively. Management functions can include administrative services such as maintaining the membership roster, **system operator**-type services such as responding to routine queries, and facilitator-type services such as coordinating the flow of messages among members and helping to establish deadlines for group tasks.

Frequently, network management services are handled by a moderator (also called an owner). The roles of a moderator can include one, some, or all of the following:

- **Facilitator**--The facilitator initiates, promotes, and channels discussion and provides help to the community.
- **Integrator**--The integrator adapts the telecommunications system to local needs to help teachers integrate network activities into the curriculum, to define goals, and to assist the new community as it connects to the network.
- **Librarian**--The librarian explains to users what information resources are available on the system and how to obtain that information.
- **Project or Community Coordinator**--The coordinator initiates and implements the community's projects and activities and ensures that participants meet their obligations and use the network to reach the goals of the group and/or the project.
- **System Operator**--The system operator provides technical assistance to the users.
- **Trainer**--The trainer instructs individual users and the group in how to use the software and hardware.

As indicated in Table 3, many electronically networked communities will be able to accomplish their educational purpose and interact using e-mail, conferencing systems, or listservs. Sample conferencing systems are CAUCUS and CONFER. Popular listservs for K-12 educators include KIDSPHERE, K12ADMIN, LM_NET, and EDTECH; however, the attributes of e-mail, conferences, and listservs vary. E-mail is more appropriate for establishing access to and connections among the individual members of a group, while conferences and listservs are better for continual and organized discussions.

Conferences and listserv discussion groups have become more useful as standard Internet connections between independent networks or systems (referred to as **interfaces**). As Internet mail transfer **protocols** have been adopted by most networks, the same conferences and discussion group archives and files are now available on **multiple hosts** (several **mainframe computers** or separate **nodes**). The adoption of the mail and other standard Internet protocols has interconnected the devices and points on a vast number of formerly independent networks where data can be sent, received, processed, and/or stored. The development and adoption of standard network utilities, such as WAIS, **Archie, Veronica** and Gopher, has provided a user-friendly procedure for **transparent log-on** between electronic networks (the ability to enter one system and get to another one easily). Table 4 contrasts some of the differences and similarities between conferences and mail lists (both e-mail and listservs).

As noted in Table 4, intervention by a moderator is common to both conferences and mail lists. Because many networked communities interact by using conferences, listservs, e-mail, or mail lists, defining an appropriate level of network management is an important part of the selection process.

Another aspect of this process involves identifying the level of communication needed. Levels of communication depend on the features and functions chosen for the network. These levels are addressed as part of the third step in the selection process.

Table 4
Comparison of the Attributes of Conferences and Mail Lists*

Feature	Conferences	Mail Lists
Discussion organized by type of message	Easy	Not possible with subject lines only (same as subject line in a memorandum)
Historical review of records	Yes	Not easy, but accomplished with the use of archival sites
Recovery of previously read messages	Yes	Not easy, unless saved or downloaded
Moderator who organizes and distributes messages	Yes	Yes
Subject review flexibility (the ability to review and search through messages)	Yes	Yes, if listserv parameters so specify
Cross-referencing of messages (messages are coded to show how many replies have been received)	Yes	Limited
Real-time communications	Sometimes	Sometimes
Access restrictions	Yes	Yes
Anyone directly on Internet† can participate if a gateway exists	Yes	Yes
Notification of new messages	Not at log-on	Yes

*Adapted from Kurland 1991.

†Internet is discussed under the heading of that name in Chapter 1.

Step 3: Matching Network Features with a Network Environment

One way to determine the features needed in a network is to look at the options available. These options can be considered in terms of the technological levels that are attainable in network communications. The levels can be divided into three phases:

- Phase 1--Fundamental Communications
- Phase 2--Interactive Communications
- Phase 3--Advanced Information Resources and Services

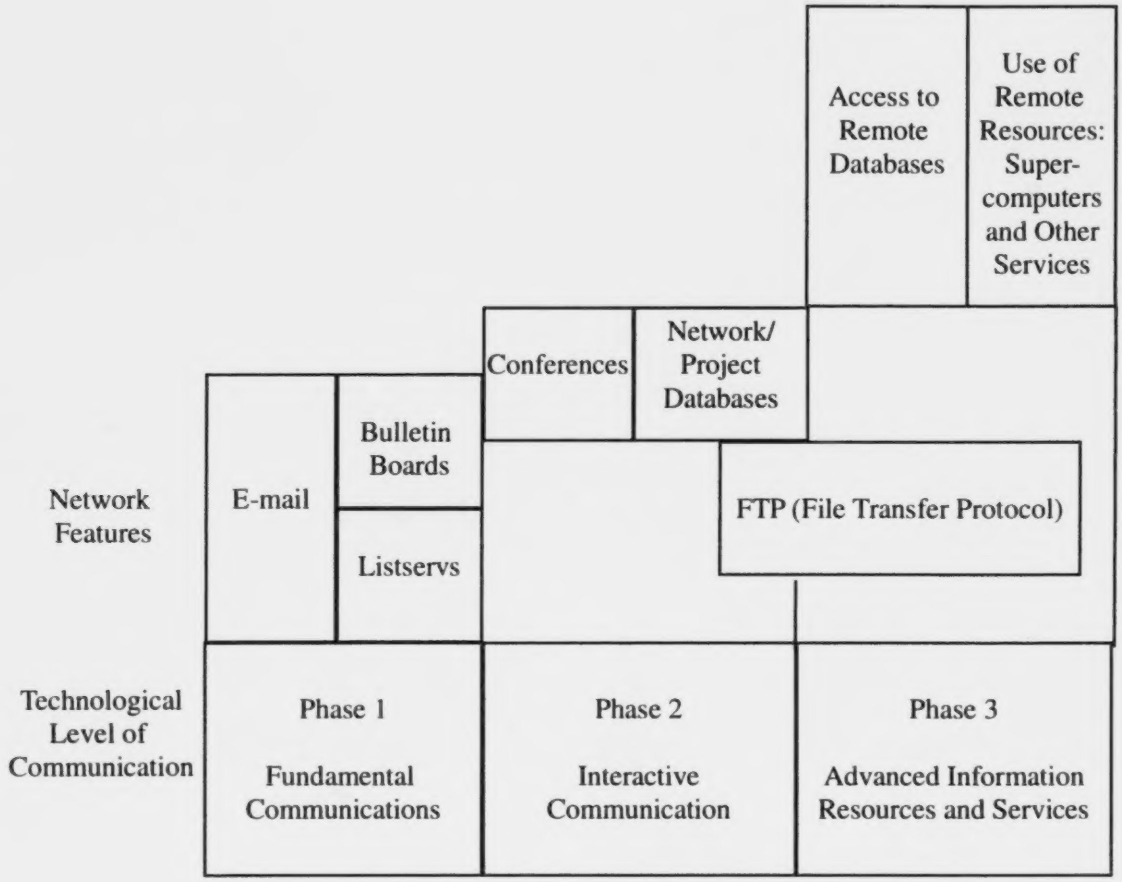
Fundamental Communications (Phase 1) include online interaction using e-mail, bulletin boards, and listserv discussion groups.

At Phase 2, Interactive Communications, users are communicating in listserv discussion groups and/or conferences, and are searching and writing to databases on the network. Some degree of file transfer is being employed as users begin to **upload** and **download** files (transferring data from one computer to the memory of another device) to reach or exceed project and community goals.

Phase 3, Advanced Information Resources and Services, involves access to and retrieval of information resources and services at remote sites. These include libraries and national archives. Users at this level often employ remote computing resources. This means that users are on a **virtual** network or one in which all networks are linked to provide the user with maximum functions. This type of virtual network is possible to some extent in the early 1990s through the Internet (this is the largest network in the world; it is discussed under "The Global Internet" in Chapter 1) and will expand through future visions of the Internet and other connected networks. The diagram below, Figure 2, depicts the types of functions or uses that are possible at each technological level of communication.

Matching network features and educational purpose with a network environment, the final step and "Connection" stage, leads to classifying existing electronic networks by type and global features. The classification of existing networks by their features is described in Chapter 3.

Figure 2 Network Features Available at Different Levels of Communication


Access to Remote Databases
Use of Remote Resources: Supercomputers and Other Services
Conferences
Network/ Project Databases
Bulletin Boards
Network Features
E-mail
FTP (File Transfer Protocol)
Listservs
Technological Level of Communication
Phase 1
Fundamental Communications
Phase 2
Interactive Communication
Phase 3
Advanced Information Resources and Services

Chapter 3

Frameworks for Classifying and Choosing Networks and Network Services

In the ideal case, it would be very simple to create an online community because everyone would be connected to the Internet, or its equivalent, and would have equivalent access to all of the functions they need for the purposes of their group. The task of creating a community would consist of getting the group organized and agreeing on common ways of working together. But in the current state of computer networks, access is uneven among people and places, and a varied range of specialized network services has sprung up to fill the growing needs for access and for information-related utilities.

In today's patchwork-quilt, computer-communications infrastructure, any group wishing to establish an online community needs to take into account the wide range of existing networks, network services, and networked communities, and then consider how well those services and communities match the needs and desires of the intended community. To help the reader understand this array of options, they are classified here under a set of somewhat arbitrary frameworks. The reader should bear in mind that this is a rapidly changing area, so the classification scheme may not endure. The frameworks are labeled:

- Commercial Information Networks (sometimes called information utilities)

- Educational Projects and online Educational Services
- Bulletin Board Systems
- Access and Service Providers
- State Education Networks

The bases of these frameworks are the factors that distinguish one network from another. These factors include:

- Participants
- **User Interface** (the boundary between the user and the computer, where a human meets a computer at the screen level)
- **Pathways** (roads or **routes** between networks)
- Internet Connections
- Support Services
- Features (conversation structure and information retrieval)
- Organization
- Costs

Examples of services, networks, and communities for each of the five frameworks are described in Chapter 4. The five frameworks and their factors are described below. The descriptions of each framework and factor are not definitive. Rather, they are explained in the context of their most common attributes. Table 5 lists the most common attributes or characteristics of each framework and some examples of it.

No one framework will match all of the present and future needs of a networked community. In most cases, however, one framework will meet the needs more closely than another. By identifying the most promising framework first, the task of choosing a particular service or combination of services for a particular community will be easier.

Framework 1: Commercial Information Networks

Commercial information networks are those that are developed and implemented by network and telecommunication businesses to provide access to general-purpose network utilities (programs that handle routine functions). These networks are designed to be complete delivery services. Among the services they offer are access to other people, support services, and specialized information resources and databases available only to users of the network. Usually, members are charged a monthly rate and, in some cases, additional fees for the time that they are connected to the network. In the general population, commercial information networks provide access to telecommunications for the largest number of users. Many of the companies that developed these networks were leaders in providing educators access to online communication.

Table 5
Major Attributes of the Frameworks with Examples

Framework	Attributes	Examples
Commercial Information Networks (information utilities)	Multipurpose; access to general-purpose, simple network functions	CompuServe, America Online, IGC, Prodigy, Scholastic Network
Educational Projects And Network Services	Project-based services; services designed for a particular project, group, or type of activity	NGS Kids Network, AT&T Learning Network, WorldClassroom, IBM's PSInet, ISTE.Net
Bulletin Board Systems	**Distributed electronic posting systems** (in which notices are taken from one network and sent to other networks), implemented locally; free or very low cost	FrEdMail, FIDOnet
Access and Service Providers	Provide services to establish connections to Internet	PSI, ANS, Internet midlevel networks
State Networks	Multipurpose networks that serve the needs of state agencies and schools	CORE, BIGSKY, SENDIT, FIRN, Learning Link, TENET, VA.PEN

Examples: CompuServe, America Online (e.g., home of SeniorNet), IGC, Delphi, Prodigy.

Participants: They are primarily households and business users, with new users coming from groups such as senior citizens, early learners, and hobbyists.

User Interface: Generally, the interface depends on the computer and is developed to meet the needs of the individual user. Interface formats are **Graphical User Interface (GUI)**.

Pathways: Commercial information networks do not usually connect to other networks or outside resources so pathways have not been needed; however, this situation is changing.

Internet Connections: Mainly, these networks exist independently, with some connections to the Internet. Most of them provide e-mail connections.

Support Services: Usually, an 800 telephone number is given to obtain answers to questions, and there is **online help** and a "help" manual.

Features: E-mail, bulletin boards, conferences, local databases, and online resources, such as encyclopedias and airline reservation systems, are available. The conversation structure is simple and often is moderated by a volunteer or a member of the network's staff. Information retrieval is limited to what is available on that particular information network.

Organization: Commercial information networks are organized primarily around individual exchanges of information.

Costs: Generally, there is a set-up fee, a monthly fee, and/or an hourly connection charge.

Framework 2: Educational Projects and Online Educational Services

Project-based networks usually serve educational entities and nonprofit organizations. Network services and educational projects are intended for an extended community of learners and organizations such as senior citizens, home learners, the general public, teachers, students, and parents. The features provided include extensive use of e-mail, bulletin boards, and various types of conferences. Projects are put together as complete packages containing support, **bundled costs**, extensive curricular materials, and telecommunications software for the particular project.

Examples: NGS Kids Network, AT&T Learning Network, IBM's PSInet, Global Learning Corporation, Learning Link and Pacific Bell's Knowledge Network.

Participants: They include teachers, administrators, curriculum designers, experts doing project-related research, and members of organizations engaged in a specific project and/or conference.

User Interface: The interfaces depend upon the individual project; some projects need highly developed interfaces, while others use simple interfaces geared to the lowest level of technology available to members.

Pathways: In general, connections cannot be made to other resources, although this situation is changing rapidly.

Internet Connections: Some of the nonprofit network projects provide e-mail connections to the Internet, but limit connections to other facilities such as file transfer protocols (FTP--operating rules that allow files and software to be retrieved from a computer and/or transferred to another computer) or remote log-in. Others are exploring the possibility of connecting to the Internet. Eventually, most online educational services will be available directly on the Internet.

Support Services: Support services depend upon the project or the choices made by the organization that formed the networked community. In some cases, these are quite extensive and include lesson materials and classroom management support as well as technical assistance.

Features: In most cases, the features are restricted to e-mail, bulletin boards, and conferences. Some organizations provide online resources and topic-specific databases. Usually, information retrieval is restricted to project or organizational needs.

Organization: The organization centers principally around conferences and projects.

Costs: Generally, they are minimal. Often, both project and telecommunication costs are quoted in one fee for the duration of the project.

Framework 3: Bulletin Board Systems

Bulletin board systems (BBS) are simple, low-cost, grass-roots electronic systems of announcing and commenting on information related to a specific subject. They are implemented locally and often connect to other BBSs on a national or an international scale. Usually, these networks serve geographically close areas and the specific needs of local users. (Sometimes, the term BBS refers to the software for starting a local bulletin board.) The services furnished include e-mail, bulletin boards, and various services related to the purpose or locality of the bulletin board. These networks cost very little and are easy to implement. To accommodate the largest number of users, the interface is still relatively simple and can be implemented on all computer systems. There are many thousands of local BBSs operating all over the world.

Examples: FrEdMail, FIDOnet, ENAN, K12net, various community Free-Nets.

Participants: They are groups interested in the topic or goals of the bulletin board. They could be a local group of teachers, ham radio operators, administrators, or computer enthusiasts.

User Interface: The sophistication of the interface depends upon the characteristics of the bulletin board software.

Pathways: Diligent attempts are being made to establish pathways for bulletin board systems to other resources that are of interest to the members and/or to the goals of the specific group.

Internet Connections: Many bulletin board systems have established connections to the Internet for e-mail. Others have extended their connections for file transfer protocols, remote log-in, and conferencing.

Support Services: Support is provided by the staff of the local bulletin board and is often minimal. Usually, there is online help, no help is available by telephone, and printed materials (such as manuals and newsletters) are limited.

Features: Bulletin boards provide e-mail, simple conferencing facilities, and bulletin boards for posting and reading messages. The information that can be retrieved is determined by the features of the host on the local network.

Organization: Bulletin boards are organized primarily around individual exchanges of information.

Costs: They are usually free or have a minimal membership fee.

Framework 4: Access and Service Providers

Access and service providers are both networks and the providers of services needed to establish, connect, and implement networks. These companies furnish the technical facilities for designing connections to networks and among institutions. The services are for institutions such as universities, corporations, government agencies, and school districts who want access to the Internet and to particular functions such as e-mail or UUCP **newsgroups** (see under the entry for UUNET in Appendix A). Some of the providers also offer accounts to individuals. Among their services are technical design, service selection, online access to a variety of resources, e-mail, and user support.

Examples: PSI, ANS, Internet-connected midlevel organizations.

Participants: The participants are determined by the entity purchasing the access and services from the provider such as a college campus.

User Interface: The interfaces are customized to meet the needs of the users, usually by the users' institution.

Pathways: The provider can supply or establish pathways to an extensive list of resources. The purchaser is responsible for obtaining access to the resources once the pathways are set up.

Internet Connections: Access to the Internet is furnished. Some of the providers of this category of services comprise a portion of the Internet backbone.

Support Services: Technical support is supplied by the provider to the participating institution, while user support is supplied usually by the institution purchasing the services.

Features: The full range of services and facilities is offered. These providers generally are at the leading edge of the state of the art.

Organization: Services are tailored to meet the requirements of the client institution(s).

Costs: The cost is based on the features selected by the purchaser. Charges for each feature are bundled (collected together) and billed in a lump sum monthly to the purchaser.

Framework 5: State Education Networks

State education networks serve the needs of a particular state and often operate across state agencies such as those for education, human services, libraries, and administration. These networks provide low-cost access for educators and gateways (links between networks that permit the transfer of information between them) from one state network to other states' networks, national networks, and international electronic network communities. State networks are in the early stages of development, with many networks being pilot-tested. The services provided include e-mail, bulletin boards, state conferences, and access to experts and resources. Many new services are being designed for networked communities that have access to state networks. An extension of this framework is one in which public broadcasting stations and other public-supported groups have developed **distributed networks** to states and within states.

Examples: SENDIT, BIGSKY, TENET, CORE, VA.PEN, FIRN.

Participants: They include teachers, administrators, researchers, professors, students, and, in some cases, parents, school board and community members.

User Interface: User interfaces are at different levels of development. Some interfaces are being designed, and standards are being established within and between states.

Pathways: Pathways are determined by the design of the state network, but usually include access to libraries, supercomputers, and other databases, particularly those accessible via the Internet, using Gopher, WAIS, **WWW** and other search and retrieval tools.

Internet Connections: Most state networks connect to the Internet for e-mail, newsgroups, the transfer of files, and remote log-in.

Support Services: Support, if any, is provided through the state agencies that manage the network.

Features: Currently, these networks provide e-mail and conferences for the use of teachers and students. Additional functions such as databases, encyclopedias, and project-based curricula are also commonly available or are in the process of being implemented.

Organization: Communities can set up any type of organization they wish.

Costs: They are either free or charge very little to educators and other members of state agencies. Sometimes, there is a minimal charge for opening an account. Usually, the local school or district bears the cost of the local area networks and user equipment.

Each of these five frameworks offers options that are appropriate for the educational purposes described in Chapter 1. Matching a framework with an educational purpose also includes considering the levels of network management, communication, and features that the community requires. Table 6 correlates purposes and frameworks with the phases of use described in Chapter 2. These phases are:

- Phase 1--Fundamental Communications
- Phase 2--Interactive Communications
- Phase 3--Advanced Information Resources and Services

Factors to Consider in Selecting a Network

The five frameworks were defined in terms of a set of factors. These factors and the issues and/or components that distinguish one network from another are discussed in this section. Collectively, these factors determine which network to select. The factors to consider are:

- Participants
- User Interface
- Pathways
- Internet Connections
- Support Services
- Features (conversation structure and information retrieval)
- Organization
- Costs

Understanding these factors will help to define networking needs further, suggest leading questions to ask the providers of network services, and crystallize the issues to address when assessing the options available. This is not an exhaustive list of all the possible factors, but one that provides a frame of reference.

Table 6
Educational Purposes and Frameworks Related to Different Phases of Use

Educational Purpose	Frameworks				
	Commercial	Educational	BBS	Access & Service	State Networks
Professional collaboration among teachers	Phase 1	Phase 1	Phases 1&2	Phase 1	Phases 1&2
Students' group investigations	Phase 1	Phases 1&2	Phases 1&2	Phases 1&2	Phases 1&2
Access to experts	Phase 1	Phase 1	Phases 1&2	Phase 2	Phases 2&3
Access to information	Phase 2	Phase 2	Phases 2&3	Phases 2&3	Phase 3
Access to computing resources	None	None	Phases 1&2	Phase 3	Phase 3
Team development among students	Phase 2	Phase 2	Phase 2	Phase 3	Phases 2&3
Teachers' professional development	Phase 2	Phase 2	Phases 1&2	Phases 1&2	Phases 1&2
Online courses	Phase 2	Phase 2	Phase 2	Phase 2	Phase 2
Support for networked community	Some at Phase 1	Phase 2	Phase 2	Phases 2&3	Phase 2

To understand better the factors and the issues related to each factor, Table 7 offers a model of the points to consider and resolve when choosing a network. The table suggests the types of questions to ask when reviewing each factor as it relates to the other factors. The table matrix is also a visual map of the interrelationships among the factors, thus providing a **knowledge base** for deciding which network to choose. The four words on Table 7--who, what, where, and how--are expanded below into a series of questions beginning with these words.

The following questions are the type to ask when using Table 7 to decide which network to select.

Who	Who are the participants?
	Who are the resources?
	With whom else can you interact?
What	What kinds of functions are available?
	What skill is needed by the user?
	What is the status of the factor?
	What level of use do I need?
Where	Where does this happen (on-line or off-line)?
	Where do I learn this?
	Where do I get help?
How	How is it organized?
	How is it accessed?
	How much does it cost?
	How easy is it to use?

Table 7
Questions to Ask When Selecting a Network

	Participants	User Interface	Pathways	Internet Connections	Support Services	Features	Organization	Costs
Participants	-	what, who	what	how, who	what, how, where, who	what, how	what, how	what, how
User Interface	what, who	-	what	what	what, who	what	what	what, how
Pathways	what	what	-	how	how, where	how, what	what, how	what,how
Internet Connections	how	what	how	-	what, how, who	what	how	what, how
Support Services	what, how, where, who	where	how, where	where	-	what, how	what	what, how
Features	what, how	what	how, what	what	what, how, who	-	what	what, how
Organization	what, how	what	what	how	what, who	what	-	what, how
Costs	what, how	what, how	what, how	what, how	what, how, who	what, how	what, how	-

Participants

The purpose here is to identify the present and future participants in the proposed community. This information is needed by the designers of the network community so that they will know whether the system is expected to grow from its original design. This factor also helps the designer to determine whether the networked community will be **open** or **closed**. An open community means that admission to it is available to all. In a closed community, admission depends on meeting a specific criterion or criteria. By identifying the participants in a proposed community, the system will be defined automatically as open or closed. Possible participants and points to consider are listed below, followed by suggestions of how to obtain information about them.

Points to Consider

- What are the prospects for connections, membership, and growth?
- Will the networked community have such participants as parents, students, teachers, school administrators, curriculum specialists, local business and community members, university and college faculty, museum personnel, and staff of state departments?
- What networks do the participants have access to already? What services are available through them?
- Are there students who want to share their research findings with other students of their own age in the global village?
- Are there students, parents, and teachers who want to collaborate in and support the learning and teaching processes?
- Will there be easy access to experts in the participants' area of interest?
- Will there be teachers, researchers, parents and others engaged in restructuring education in the networked community?
- Will the networked community serve the purchasing public?
- Will the networked system be open or closed? How will access be denied?

- What types of institutions will participate in the networked community?
- What are the current networking skills of the potential participants, the networking experience of the prospective community, and existing connections to networks?

How to Obtain Information

- Identify participants whose activities relate to the purpose of the project.
- Determine the types of participants necessary to meet the educational objectives of the networked community.
- Analyze the advantages, disadvantages, and impacts of an open or a closed system.
- Find out what networks the participants are using already.

User Interface

The ease with which users can access, and make their way through, an electronic network is critical to the amount of participation in, and the success of, a project. User interfaces (the boundaries between the user and the computer, where the user meets the computer at the screen level) vary widely, from convenient and structured **menus** or **windows**, to easy-to-learn customized interfaces, to simple text interfaces that lend themselves to the most basic hardware, and, finally, to networks offering little interface design for the user. Electronically networked groups are beginning to discuss connection problems. As a result, several new and convenient interfaces have appeared. Users have indicated a desire for connections between systems that cost little or nothing, are in the public domain, and provide **source code** (the primary computer **code** for the program) that can be modified by a networked community.

Several interface standards for users are available or are being developed by user groups for networked communities. Aspects being discussed include menu versus **icon/window screens**, terminology and format for searching, hardware-adjustable interfaces, access to and **portability** between electronic networks, and user platforms. Interface standards range from primitive interfaces to very elaborate interfaces. In addition, there are specialized interfaces for searching databases (e.g., WAIS--Wide Area Information Servers, which enable a user to search and access different types of information on many different computer systems from a single interface connection); group interaction (UUCP newsgroups--see the entry for UUNET in Appendix A); and **mail agents** for reading, sending, and filing network mail.

Points to Consider

- Is the interface in the public domain and, therefore, free?
- Will the intended participants find the interface easy to use?
- Will it be easy to customize or modify the interface specifically for the purposes of the community?
- Will the provider of the interface furnish a help session online?
- If the interface is not free, is it inexpensive?
- For purposes of the intended community, is it important that all of the participants have the same interface?

How to Obtain Information

- Investigate the interfaces available on the network selected.
- Talk to the provider or designer of the network about having it customized to the community's specifications.
- Obtain training programs and manuals to help the system operator make modifications.

Pathways

This factor is designed to help answer the question, "Where do I want to go from here?" Pathways include the connections between providers of information sources and the technical roads for getting there; they also include those networked communities that exist to facilitate the acquisition of knowledge. To answer the question asked above, users will need to know what information resources exist, how to access them, and how to obtain information from them. Thus, the user will need to be familiar with technological features such as file transfer protocol (FTP--the Internet's standard rules that enable computers to access, retrieve, and transfer information) and **X.500** (a global directory service that provides addressing and communications information), as well as Gopher, WAIS, Archie, and other Internet tools and utilities (see Glossary).

Points to Consider

- Does the pathway provide access to educational institutions, government agencies and laboratories, research facilities, and supercomputer facilities?
- Can the pathway access databases for research and findings in order to conduct research and analyses?
- Can data and results be shared with practitioners, researchers, teachers, and students?
- What are the technical requirements for access?

How to Obtain Information

- Identify personnel and institutions that will provide information on **addressing conventions**, **operating system** compatibility, and software needs.
- Ascertain what information resources and facilities are available for accomplishing the networked community's educational purpose.
- Obtain access to and procedures for accessing information, databases, libraries, and video libraries.
- Establish working relationships with practitioners, researchers, teachers, and students for additional resources.

Internet Connections

The Internet is a powerful route to accessing and retrieving information because it provides extensive connections to other resources. Through the Internet, users can gain easy access to commercial networks, **BITNET**, educational networks, UUCP newsgroups (see the entry for UUNET in Appendix A), government networks, international networks, libraries, and more. Many documents are available to enable users to find their way around the Internet and to take advantage of all that it offers.

Points to Consider

- What are the procedures for acquiring an account on the Internet? (This varies by institution and locality.)
- Are there local connections to the Internet from the participants' institutions?
- What Internet functions are needed by the networked community?

How to Obtain Information

- Obtain an Internet Users' Guide (several are available--see Appendix D).
- Work closely with an Internet service provider (see Framework 4) that can provide access to the Internet for all participants.
- Know what and who you want to access by the Internet.

Support Services

Commitment to support services is crucial to the acceptance and use of a network. Support services should be considered in three areas: user support, technical support, and network and community support. In some settings, user support and technical services are available 24 hours a day from a toll-free telephone number. Other networks offer technical assistance only through a toll-free telephone number and handle questions about software through a long-distance call. It is important to know what support services are offered by the entity that furnishes the network. Users also should be advised how to access information resources and technical assistance online.

Points to Consider

- Will support services be provided to users of the network?
- Is help readily accessible through an 800 toll-free telephone number?
- Is there someone on the user's staff or in the networked community who can provide assistance?
- Is anyone on the staff an educator, with K-12 teaching experience?
- Is help obtainable from the company supplying the network?
- Is help offered online by the company supplying the network?
- Are documentation, guides, and manuals available in hard copy (printed on paper) and online?
- Are there training workshops, videos, and other materials that explain how the network operates?
- Is help available for establishing local connections?

How to Obtain Information

- Establish sources of help that are available by telephone and online.
- Have the school's computer coordinator trained to furnish support services by the company supplying the network.
- Train a core of teachers to serve as support personnel.
- Obtain documentation explaining how to use the network and the services available on it.
- Determine when person-to-person support services are available (24 hours a day, during school hours only, etc.) and to whom these services are given (students and teachers only, or parents too).
- Maintain relations with vendors to ensure that changes and updates are brought to the attention of the system operator.

Features

This factor can be analyzed in two distinct ways--conversation structure and information retrieval. Conversation structure refers to networks on which the users transmit or exchange information by such means as bulletin boards, conferencing systems, and individual electronic mail. Information retrieval refers to features and services that facilitate access to and retrieval of information from databases or libraries.

Conversation Structure

This part of the factor identifies the modes of interaction and the features that the network will use, such as e-mail, bulletin boards, listserv discussion groups, and conferencing. E-mail and bulletin boards are the most basic forms of electronic communication. Messages (mail) are keyed in and transmitted electronically (posted) to an individual or to a bulletin board. Listserv discussion groups and other conferencing systems provide a slightly more advanced method of communication by offering some archiving capabilities. Moderated conferences can provide even more capabilities. The roles that moderators can play vary from having absolute control over conferences and messages which are approved for posting, to facilitating discussions, or to offering maintenance of the archives only.

Points to Consider

- Can knowledge be easily communicated to and shared with other students, teachers, classes, practitioners, and researchers?
- Is there access to researchers and practitioners to get their feedback on various issues? Can users participate in networked communities that discuss professional development issues?
- What bulletin board systems are offered?
- Can access be made in timely fashion to the network and to the services that can be reached through it?

How to Obtain Information

- Establish e-mail accounts for all of the participants. Acquire bulletin board and conferencing capabilities for the network.

Information Retrieval

To retrieve information, a network must be structured so that libraries and archives can be searched, databases can be installed, and online courses can be accessed. Users retrieve information themselves, rather than interact with resource providers. Users need to be able to locate, access, search, download, update, and upload information resources.

Points to Consider

- Is there access to archives, databases, libraries, and other sources of knowledge and data?
- Can classes or groups participate in online courses?
- Can collaborations to build learning skills be developed?
- Can knowledge bases be built easily by the participants?
- Can a WAIS server or similar capability be set up for the community?

How to Obtain Information

Find out how to gain access to databases, libraries, and file transfer protocol (FTP) procedures.

Organization

This section deals with how the individuals and the knowledge on the network are organized and accessed. The possibilities range from one where the individual members control all of the choices and how messages are sent and received to one in which the users participate in a highly organized group structure, with one or more moderators or leaders. In a highly structured networked community, groups are often referred to as **clusters, learning circles, forums,** or conferences. Conversations within these limits extend from one-on-one at the individual level to group collaborations and group activities at the other end of the scale.

Points to Consider

- How do users participate in conferences and listserv discussion groups?
- How do users join a group? How are messages sent and received?
- What is the overall design of the network? Does it have a menu-driven architecture or a decision-tree architecture?

How to Obtain Information

- Ask the network manager or the project director how the network will be organized.
- Consult online information for how to join lists, conferences, or forums.

Costs

Costs should be thought of in two ways: the costs of creating and sustaining an online community versus the costs of creating and maintaining networking infrastructure. At the present time these two issues are co-mingled because the infrastructure is uneven among institutions and localities.

If the intended participants in a networked community do not have access to computer-communications networks currently, the creator of the community usually tries to find the least costly means of getting the participants connected. This may not be the most cost-effective way of building an equitable networking infrastructure, but it is necessary sometimes as a short-term tactic.

If many of the intended participants do not have a direct-connection (i.e., hard wired) access to a network, an alternative solution is to have them acquire **modems** and use **dial-in** access to a network. Costs such as purchasing modems, LANS, or **routers** and installing telephone lines should not be considered part of the cost of one particular online community or activity. Rather, these are costs associated with building the local communications infrastructure. The costs of local infrastructure (within a school or campus) should be amortized over a wide range of network **applications**.

Other cost factors associated with creating and sustaining an online community include:

- telecommunications costs
- fees for commercial information services or databases
- purchase of network interface software and hardware
- moderator's salary
- training for participants

Summary

The above points and the suggestions of how to obtain information about them will help decision-makers to analyze and evaluate the options available to them in setting up a networked community. All frameworks and services have their advantages and disadvantages, and planners should be aware of them when selecting a network or network service. Table 8A identifies the main strengths of each framework by individual factor and gives examples of existing networks in the particular framework that illustrate these strengths. Table 8B indicates the main weaknesses of each framework, again by individual factor. Certainly, exceptions can be cited for nearly every strength and limitation listed; similarly, other examples would fit the particular factor addressed.

In using these tables, planners can scan the strengths and weaknesses to learn more about the factors that distinguish one framework from another or one factor from another by framework. The examples are described in chapter 4 or Appendix A. For ease in reading Table 8, the full names of the frameworks are:

- Commercial Information Networks
- Educational Projects and online Educational Services
- Bulletin Board Systems (BBS)
- Access and Service Providers
- State Education Networks

Table 8A
Major Strengths of the Framework, with Examples

Factor	Frameworks	Strengths	Examples
Participants			
	Commercial	Members are generally household consumers and businesses	CompuServe, America Online
	Educational	Members come from educational groups and organizations	ISTE.Net
	BBS	Members usually have a common interest	FrEdMail
	Access and Service	The membership determines the design of the network	Midlevel networks of Internet
	State Networks	Members are teachers, researchers, administrators, and students	FIRN,VA.PEN, CORE
User Interface			
	Commercial	Interface tailored for members who use different computers	America Online
	Educational	Interfaces are designed for specific uses	TERC Global Lab
	BBS	Interface is designed to accommodate the lowest level of technology available to users	FIDOnet
	Access and Service	Developing user interfaces for clients' needs	PSI
	State Networks	Working with other states to develop standards	TENET,CoSN

Table 8A Continued

Factor	Frameworks	Strengths	Examples
Pathways			
	Commercial	All activities are available through the network	CompuServe
	Educational	All activities are on one host or through one project	NGS Kids Network
	BBS	Provide pathways appropriate for the focus of the BBS	K12net
	Access and Service	Access to all levels of resources on Internet	PSInet
	State Networks	Developing pathways to a variety of resources	TENET
Internet Connections			
	Commercial	Most are exploring and implementing e-mail connections to Internet	CompuServe
	Educational	Some provide a path to Internet for e-mail	AT&T Network
	BBS	Connected through a distributed network to Internet	Big Sky Telegraph
	Access and Service	Full connections to Internet	Regional networks of Internet
	State Networks	Established on or with direct connections to Internet	VA.PEN, CORE

Table 8A Continued

Factor	Frameworks	Strengths	Examples
Support Services			
	Commercial	Usually provide extensive on-line and off-line help	CompuServe, America online
	Educational	Support services are delivered by user groups or commercial provider	AT&T Network
	BBS	Support is determined by local system operators	FrEdMail
	Access and Service	Extensive technical support to the network institution	ANS
	State Networks	Help is given by the agency managing the network	FIRN
Conversation Structure			
	Commercial	Well-developed services such as e-mail and BBS	America Online
	Educational	Extensive use of e-mail and conferencing	AT&T Network
	BBS	Extensive use of bulletin boards and file transfer	UUCP (UUNET)
	Access and Service	Any	Midlevel networks
	State Networks	Use of e-mail, newsgroups, and bulletin boards	TENET, VA.PEN, CORE

Table 8A Continued

Factor	Frameworks	Strengths	Examples
Information Retrieval			
	Commercial	Use of databases and online courses	CompuServe
	Educational	Access to selected databases and other information for the organization doing the project	NGS Kids Network
	BBS	Developing databases for users and collaboration with experts	FIDOnet
	Access and Service	Access to databases and other Internet information	Mid-level networks of Internet
	State Networks	Connections to Internet resources being added; controlled access to selected resources	TENET, VA.PEN,CORE
Organization			
	Commercial	Information is organized around individual choices, topics, or work groups	CompuServe
	Educational	Often organized by clusters for group conversations	AT&T Network
	BBS	Provide individual conversation, organized by topic or project	FrEdMail
	Access and Service	Any	PSI, ANS, Midlevel networks
	State Networks	Organized for individual and collaborative activities	Many state networks

Table 8A Continued

Factor	Frameworks	Strengths	Examples
Costs			
	Commercial	Telecommunications costs bundled with service; low monthly and off-peak charges	CompuServe
	Educational	Projects have "bundled" costs (all of the features are grouped into one cost)	IGC
	BBS	No cost for local connections	FIDOnet
	Access and Service	Arrange all aspects of connections	PSI
	State Networks	Costs are integrated with other state services	TENET, FIRN, CORE

Table 8B
Major Limitations of the Frameworks

Factor	Frameworks	Limitations
Participants		
	Commercial	Generally teachers and students are not active
	Educational	Access limited to group members or project members
	BBS	Access limited to group or locality
	Access and Service	Difficult to identify a community on the Internet
	State Networks	Access limited to individuals from state agencies
User Interface		
	Commercial	Interface is designed for a specific network only
	Educational	Interfaces are often project- or service-specific
	BBS	In most cases, interfaces must be provided by the user
	Access and Service	Interfaces vary and depend on the purchaser's needs
	State Networks	Interface is unsophisticated because the users are so varied
Pathways		
	Commercial	Limited to the materials selected by the network's owners
	Educational	Mostly project- or organization-based and not open
	BBS	Lack of access to other areas or networks
	Access and Service	Pathways are determined by the needs of the majority of users
	State Networks	State networks are new and not fully developed

Table 8B Continued

Factor	Frameworks	Limitations
Internet Connections		
	Commercial	Access to Internet is often difficult because of addressing conventions
	Educational	Some provide access, but addressing conventions are complicated
	BBS	Connections established, but usually only e-mail is available
	Access and Service	Provide Internet connections primarily to institutions' campuses
	State Networks	At early stages for providing information across Internet
Support Services		
	Commercial	Saturated at peak times
	Educational	Support is high quality, but available only for the project or organization
	BBS	Help is often not formalized or consistent
	Access and Service	Support is not usually for the end user
	State Networks	Services and training are being defined
Conversation Structure		
	Commercial	Tendency to have too much information irrelevant to a particular community
	Educational	Moderation of conferences is inconsistent
	BBS	Structure for forming and joining conferences is limited

Table 8B Continued

Factor	Frameworks	Limitations
	Access and Service	Not applicable
	State Networks	Many users have not adopted online communication methods
Information Retrieval		
	Commercial	Access to outside resources is not usually available
	Educational	Resources are designed for limited use and restricted access
	BBS	Size of servers is often limited so there is insufficient space for databases
	Access and Service	Resource allocation and access are being assessed
	State Networks	Experiencing technical difficulties in addressing and retrieving data
Organization		
	Commercial	Conversations are continuous and it is difficult to join an existing one
	Educational	Not well designed for activities other than project
	BBS	Organization fluctuates depending on the needs of the group
	Access and Service	Users determine the methods for organizing knowledge
	State Networks	Hard to follow and track group conversations because so many are going on simultaneously

Table 8B Continued

Factor	Frameworks	Limitations
Costs		
	Commercial	Difficult to budget because of varied monthly costs
	Educational	Costs are usually project-based and not continual
	BBS	Expensive to connect to if outside the local BBS area
	Access and Service	All costs are hard to identify because they are not itemized individually
	State Networks	Hard to obtain and identify local start-up costs

Chapter 4

Representative Network Services

This chapter describes some network services that illustrate the frameworks developed in Chapter 3. Each network was analyzed using the factors defined in the previous chapter. Appendix A contains brief descriptions of other networks or projects mentioned in this *Guide*.

Framework 1: Commercial Information Networks

➳ **America Online**
Quantum Computer Services
8619 Westwood Center Drive
Vienna, VA 22182
800-827-6364

America Online is an all-purpose, online information computer service. It offers its members e-mail, conferencing, **message boards** (bulletin boards), software to download, hardware and software support, games, **transactions**, news, financial information, and educational services, including access to online classes and encyclopedias. It is designed for multiple platforms, which means that it will work on different makes of computers and different programs such as Apple, Macintosh, and **DOS**. Members of America Online can join many communities. For example, SeniorNet is a networked community that has topics of interest to senior citizens. Scholastic Network is also on America Online.

Participants: They include home computer users and businesses.

User Interface: America Online provides an easy-to-use, graphic user interface to the network. The software runs on the user's computer and is designed to connect to America Online. It contains menus for selecting the function to be performed and for transferring files.

Pathways: There is access to networks that allows online ordering and purchasing.

Internet Connections: E-mail is exchanged with the Internet. Full connections to the Internet are now available.

Support Services: Support services are provided online, and technical support is provided through an 800 toll-free telephone number. Support is provided for communities to tailor their own interface and conversation structure.

Conversation Structure: Features include e-mail, message (bulletin) boards, and conferences.

Information Retrieval: Users can download software and access databases and libraries.

Organization: America Online is organized around individual activities and offers the possibility of interacting with groups through conferences.

Costs: Costs are $9.95 a month per user account with 5 free hours monthly. There is a charge of $3.50 per hour after the 5 free hours. The first month's fee is waived and there are 10 free hours. Fees apply for special third party services.

CompuServe
5000 Arlington Centre Boulevard
P.O. Box 20212
Columbus, OH 43220
614-457-8600
800-848-8199

CompuServe is an online information service designed for the instantaneous retrieval of information. Its target markets are families (adults and children) and office workers. Over 500,000 members access the service through a local telephone call. CompuServe offers e-mail, conferences, **chats** (chats; several people can send private messages to each other in real time, without other members of the network receiving them), forums, and the exchange of information on a variety of topics. Access to many of the largest databases in the world can be achieved through CompuServe. Comprehensive and varied information, such as online databases dealing with news, financial services, and travel reservations, and forums and conferences dealing with computer and telecommunications software, is on call. Educational forums have been established for several fields, among them science, mathematics, space, astronomy, and computing. Some online courses are conducted through these educational forums.

Participants: Users include businesses, individuals, home computer users, and extended learner groups.

User Interface: The user either provides local telecommunications software or uses CompuServe's own interface for specific computers. The Macintosh interface is **icon-driven** and window-driven.

Pathways: CompuServe provides access to **MCI Mail** and **AT&T Mail**.

Internet Connections: Users can receive mail from and send to the Internet.

Support Services: Over 85 percent of the membership can access help services through a local telephone number. An 800 toll-free telephone number can be dialed for customer service. Online help is available, as are forums for hardware and software support.

Conversation Structure: Members usually communicate through forums, conferences, and e-mail.

Information Retrieval: Files from other sources can be uploaded and downloaded. Resources include reference and consumer databases.

Organization: CompuServe is organized around individual activities, with options to interact with groups through forums and courses.

Costs: There is a one-time membership fee of $39.95, for which members receive a usage credit of $25 toward extended services (to be used for access to the system), telecommunications software, a magazine subscription, and a user's guide. After the access credit has been used up, CompuServe charges a basic connection rate of $4.80 an hour or $9.60 an hour, depending on the baud rate (the speed at which the data are transmitted) and there is a surcharge for some services. There is no fee for the first month's services.

IGC (Institute for Global Communications)
PeaceNet EcoNet ConflictNet
18 De Boom Street
San Francisco, CA 94107
415-442-0220

IGC is an educational organization and a computer-based communications and information-sharing system. Its mission is to encourage the effective use of computer telecommunications by individual organizations working toward environmental preservation (through EcoNet); peace, human rights, and social justice (through PeaceNet); and conflict resolution (through ConflictNet). IGC provides e-mail, electronic conferences, and online databases and is accessible through the Internet, **SprintNet**, and direct dial.

While instruction from kindergarten through grade 12 is becoming more involved with peace education and conflict resolution, environmental education on EcoNet is used more often in these age groups. IGC offers information from over 200 online conferences dealing with environmental issues. PeaceNet can be accessed by over 70 countries through their local telephone systems. IGC is a member of the Internet and has gateways to many international systems and mailing systems. These gateways enable IGC to act as an access and a service provider too.

Participants: Users include individuals, commercial organizations, nonprofit organizations, businesses, and groups involved in environmental, social, economic, political, and other issues.

User Interface: The interface is **text-driven** by menus to accommodate a variety of computers and programs, from very simple to sophisticated, window-based systems.

Pathways: IGC maintains gateways to over 50 other networks like AT&T, the Internet, SprintNet (**Telenet**).

Internet Connections: IGC has access to the Internet and pathways to other networks.

Support Service: Most support services are available through online documentation, which is often obtainable on the system at the host site, and exchanges of e-mail with a system operator. Help is also available by telephone, but it is not a local call.

Conversation Structure: Members communicate through e-mail, bulletin boards, and conferences.

Information Retrieval: IGC offers databases on a range of peace and environmental topics.

Organization: The network is organized around group conferences related to the topics of the specific network.

Costs: There is a one-time, sign up charge of $15 (plus $10 for a manual), with a monthly fee of $10. This includes one hour of off-peak connection time each month. Additional connection time costs $5 an hour off-peak and $7 an hour at peak times. Group discounts are available.

Framework 2: Educational Projects and Online Educational Services

➳ **AT&T Learning Network**
P.O. Box 4012
Bridgewater, NJ 08807-4012
800-367-7225

For selected curricular units, the AT&T Learning Network brings classes together in learning circles. The learning circles support whole language, creative, and expository writing; history, geography, culture, and government; and units that support energy and the environment, society's problems, and global issues. Teachers register for a unit and students share the learning experience with participants in other learning circles.

Participants: They include educators and students from kindergarten through grade 12. Learning circles are grouped by grade; for example, grades 3 through 6, 6 through 9, and 9 through 12.

User Interface: The interface is **menu-driven** and designed for use on multiple platforms (different computers and different programs). Users can connect easily to AT&T Mail and can send and receive messages automatically.

Pathways: This is a closed system, meaning that access from outside the assigned learning circle is not usually possible.

Internet Connections: Selected users can access e-mail through an Internet gateway.

Support Services: Participants receive free answers to curricular questions, access to a free hot-line number, a training **diskette** and materials, and a monthly newsletter.

Conversation Structure: Conversation takes place mostly through e-mail, using the AT&T Mail network.

Information Retrieval: Project activity files and pertinent publications can be downloaded.

Organization: The network is organized around group activities and clusters called learning circles.

Costs: The cost depends on the unit selected. A 6-week unit costs $195; an 11-week unit costs $375; and a 15-week unit costs $375. This fee includes curricular materials, communications software, and unlimited, toll-free, computer communications for all participants.

NGS Kids Network
National Geographic Society
Educational Services
Dept. 5413
Washington, DC 20036
800-368-2728

The National Geographic Society's Kids Network offers a geographic science curriculum for grades 4 through 6 and is expanding to the middle school level. This curriculum encourages new ideas by promoting the exchange of information and findings with students around the world. It is a hands-on program, with students conducting original research and learning about scientific processes as they examine issues. The science curriculum consists of a series of eight-week units. Units scheduled for 1991 and 1992 include "Acid Rain," "What Are We Eating?," "What's in Our Water?," "Weather in Action," and "Too Much Trash." Geographic mapping, telecommunications, and word-processing tools are built into the NGS Kids Network to enhance graph-making, map reading, and language arts skills.

Participants: Users include students and teachers in grades 4 through 6, scientists, and experts worldwide.

User Interface: The highly graphic interface has been developed specifically for the project and for use on multiple platforms.

Pathways: This is a closed system without access to other networks.

Internet Connections: There is no access to the Internet.

Support Services: Support services include an 800 toll-free telephone hot line for answers to technical questions, an online history (which is a log of the user's personal activities), a software manual, a tutorial disk, and a teacher's guide with lesson plans.

Conversation Structure: Members communicate through e-mail.

Information Retrieval: Members communicate, upload and download files using SprintNet from the NGS Kids Network server.

Organization: The network is structured so that activities are conducted through groups assigned to a specific unit.

Costs: The cost for a kit is $325 or $375, depending on the unit selected. Units cost $115 for an 8-week session.

➳ **Scholastic Network**
Leslie Lichter, Marketing Director
Scholastic Inc.
740 Broadway, 12th floor
New York, New York 10003
212-505-5818
800-864-0425

Scholastic Network is the first online service designed especially for teachers, students and schools. The Network gives teachers the ability to share professional insights with thousands of colleagues across the nation, in every curriculum area. There are professional discussion areas for principals, technology coordinators, and library media specialists. Scholastic Network offers collaborative projects and classroom tested lesson plans--in science, math, social studies, and language arts.

With its link to America Online, Scholastic Network also provides access to information resources, including online encyclopedias, current events news wires, electronic versions of major newsmagazines, and more.

Scholastic offers a free 30-day trial membership so educators can preview the Network with no commitment. If a network member recommends the service to a friend and that friend joins, the referring member will receive 5 hours of online time for free.

Participants: Users include teachers, students, library media specialists, curriculum coordinators, computer coordinators and principals.

User Interface: The highly graphical interface has been developed specifically for the project and for use on all major platforms (Mac, DOS, Windows).

Pathways: See Internet Connections.

Internet Connections: Scholastic Network provides Internet access, including e-mail, newsgroups, listserves and WAIS and Gopher databases.

Support Services: An 800 toll-free telephone line for answers to technical and content questions, information, and free trial subscriptions.

Conversation Structure: Scholastic Network offers message boards and e-mail for teachers and students around the world to exchange ideas. Message boards and Live Chats are available for classes to talk with famous authors, scientists and other experts.

Organization: Scholastic Network and Internet services are operated and managed by the Technology Division of Scholastic Inc., leading publishers and distributors of children's books, classroom and professional magazines, educational software and instructional materials.

Costs: School year account costs range from $295 per account for single accounts to $225 per account for multiple accounts purchased together. Each account includes 5 hours of access time per month. Additional hours may be purchased in bulk.

Framework 3: Bulletin Board Systems

FIDOnet
K12net (subset of FIDOnet)
Jack Crawford
Wayne/Finger Lakes Teacher Resource Center
3501 County Road 20
Stanley, NY 14561
716-526-6431

FIDOnet is a bulletin board-type organization of over 12,000 nodes worldwide (a node is the beginning, intersection, or end of a communications link or the device located at any of these points; data can be sent, received, processed, and/or stored at a node). Each local BBS is autonomous, but files and communications are exchanged between systems. **Echo forums** (the capability to forward comments received during an online discussion or conference to people in other conferences and other networks who did not participate in the discussion) are established in major curricular areas so that all messages sent to a specific topic area (on a list, conference, forum, or newsgroup) are shared with those interested in the same area. Forums also are set up to accommodate short-term classroom projects involving student groups in any part of the network. The software transfers e-mail automatically between the modes. Network administration is handled by coordinators of the nodes at the various levels of its **routing hierarchy**, with assistance from the International FIDOnet Association (IFNA).

K12net, a subset of FIDOnet, is actively using the FIDOnet bulletin board system to provide free, local, computer-moderated, communications capabilities to as many teachers, children, and parents as possible. Students and teachers throughout North America, Australia, Europe, Asia, and the former U.S.S.R. participate in curriculum-related conferences at no cost, usually through a local telephone call. A K12net library contains files that cover every spectrum of education. These files are available to all of the participants in K12net.

Participants: K12net transfers its conferences into USENET newsgroups (see under the entry UUNET in Appendix A) to make them accessible over the Internet.

User Interface: The interface is text-based. The user selects the telecommunications software.

Pathways: Gateways are established to USENET (see under the entry UUNET in Appendix A) and BITNET. FIDOnet reaches places where the Internet and BITNET do not.

Internet Connections: Access to the Internet is achieved through nodes to networks worldwide and through the Internet infrastructure.

Support Services: Support services are provided by local system operators, who are frequently volunteers.

Conversation Structure: Members communicate through bulletin boards, e-mail, and conferences.

Information Retrieval: Files can be retrieved and information accessed from databases.

Organization: Activities are project-based, with groups organized online by area of interest. In addition, individuals use the system extensively for e-mail and bulletin boards.

Costs: This is a free service.

➳ **FrEdMail (Free Educational Electronic Mail Network)**
FrEdMail Foundation
Al Rogers, Executive Director
P.O. Box 243
Bonita, CA 91908-0243
619-475-4852

FrEdMail is the oldest and largest educational network in America. Its motto is "Linking Students and Educators Around the Globe." FrEdMail consists of 150 bulletin boards, each representing a node on the network. An NSFNET electronic networked infrastructure eliminates long-distance charges for transferring files between nodes. The goals of the FrEdMail Foundation are to promote:

- the development of effective reading, writing, and communication skills in students at all grade levels;
- the development of geographical, cultural, and sociopolitical understanding on a global scale;
- contacts among all segments of the community, such as schools, universities, community service organizations, and others, and to encourage these segments to have closer working relationships with schools;

- a better understanding of telecommunications technology and to advocate and facilitate its responsible and effective use in schools and classrooms across America;
- the development of a low-cost, community-based, electronic data communications network owned by public agencies such as schools, libraries, cities, and other community service organizations, with the objective of providing all citizens equal and free or low-cost access to the basic tools of information access, retrieval, and transmission.

Participants: Users are mostly educators, students, and teachers from kindergarten through grade 12.

User Interface: The interface uses FrEdMail-designed software and is text-based.

Pathways: A gateway through a UNIBASE system in Canada provides connections among FrEdMail, BITNET, UUCP (see under the entry UUNET in Appendix A), and FIDOnet.

Internet Connections: FrEdMail users can exchange mail with the entire Internet community through gateways, including a large number of teachers from kindergarten through grade 12 who are on the Internet.

Support Services: Support services are provided through local systems. The goal is to provide teacher training, support, and materials nationwide.

Conversation Structure: Members communicate through the use of bulletin boards, e-mail, students' e-mail projects, and mailing lists.

Information Retrieval: Connection to the Internet increases opportunities for access to and retrieval of information.

Organization: Individuals share access to bulletin boards and e-mail. Activities are conducted through group projects designed and implemented by teachers.

Costs: FrEdMail accounts are free, the only costs are those related to connecting to the nearest node.

Framework 4: Access and Service Providers

➳ **ANS (Advanced Network & Services, Inc.)**
100 Clearbrook Road
Elmsford, NY 10523
800-456-8267
info@ans.net

ANS designs, develops and operates high performance wide area data networks for businesses, research, education and government organizations.

ANS operates the only nationwide TCP/IP public data network operating at 45Mbps and provides Internet connectivity to customers on a dedicated line and dial-up basis. ANS offers network analysis, design, and engineering services as well as state-of-the-art Network Operations Center outsourcing. ANS InterLock family of services is recognized as the leading suite of TCP/IP security solutions to ensure enterprise network integrity, user authentication, resource accounting and data privacy. ANS has managed and operated the NSFnet Backbone Service since 1990.

ANS services are provided by Advanced Network & Services, Inc., and ANS CO+RE Systems, Inc., its wholly-owned subsidiary.

(ANS InterLock is a service mark of ANS CO+RE Systems, Inc.)

Participants: Any individual or organization who wants to connect to the Internet, such as business, research, education and government organizations.

User Interface: Customer software or ANS-provided, custom-designed interfaces can be used by Internet users.

Pathways: Users gain access to the more than 25,000 networks, which make up the Internet, through ANSnet, and nationwide T3 backbone.

Internet Connections: ANS provides Internet connections from dial-up to dedicated access speeds.

Support Services: Support services are available 24 hours a day through ANS' Network Operations Center. Other services include security services, technical assistance, training seminars, consulting services, and a newsletter.

Conversation Structure: The standard means of communication among Internet users--e-mail, bulletin boards, and mailing lists--are accessible over the ANSnet.

Information Retrieval: Customers can use FTP (file transfer protocol--the Internet's standard application protocol for transferring files between network nodes) and TELNET (the Internet's mechanism for providing interactive remote login capability from one computer to another computer) to access and retrieve information.

Organization: Customers choose their method of organization, either individuals or groups of users.

Costs: Costs depend upon the speed of service desired and any additional features chosen.

PSI (Performance Systems International, Inc.)
1180 Sunrise Valley Drive, Suite 1100
Reston, VA 22091
800-82P-SI82

PSI provides the hardware and software for individual hosts or entire local area networks (LANs) to achieve access on demand to PSInet, a portion of the Internet. PSI also will connect the members of a networked community. Customers dial local telephone numbers to access a PSI **terminal server** located in a major metropolitan area. This system supports the TCP/IP protocol (Transmission Control Protocol/Internet Protocol), the application and transport protocol for electronic network communications, including **MSDOS**, UNIX (an operating system--see under the entry for UUNET in Appendix A), and Macintosh platforms.

PSI offers UUPSI e-mail and USENET/NEWS Service (see under the entry for UUNET in Appendix A). USENET/NEWS is a form of **distributed electronic bulletin board**, which reaches 1.5 million people worldwide. It is an effective way of circulating information, reading findings, and participating in "keyversations." News articles are divided into categories called newsgroups and arranged **hierarchically** (i.e., by topic, subtopic, subsubtopic, etc.). In addition, a monthly newsletter is published for subscribers.

Participants: Anyone who wants to access to the Internet.

User Interface: An easy-to-use interface is available for e-mail functions. Other interfaces are developed between PSI and the group contracting with PSI.

Pathways: Users gain access to all Internet gateways.

Internet Connections: Direct access to the Internet is provided.

Support Services: Operational support is furnished by PSI's Network Information and Support Center (NISC) 7 days a week, 24 hours a day, through a toll-free telephone number.

Conversation Structure: Participants communicate through e-mail, bulletin boards, and conferences.

Information Retrieval: Members can upload and download everything that is accessible through the Internet.

Organization: The purchaser chooses the structure, which usually is organized around individual or group use.

Costs: There is a one-time registration fee of approximately $19 to $500. Monthly fees start at $9 and up, depending on the type of contracted service and connection desired.

Framework 5: State Education Networks

➳ **CORE (California Online Resources for Education)**
Keith Vogt, Director
California Technology Project
P.O. Box 3842
4665 Lampson Avenue
Seal Beach, CA 90740-7842
310-985-9631
800-272-8743

CORE provides e-mail, bulletin boards, conferencing systems, database services, remote log-in, Gopher, and **remote file transfer** to educators from kindergarten through grade 12 in California. The system supports collaboration among educators at all levels, from kindergarten through postsecondary education.

Participants: They include administrators, teachers, and students from both public and private schools from kindergarten through high school, as well as those in business and higher education who work or cooperate with schools in California.

User Interface: This single-host-based system generates a simple, menu-driven interface that can be accessed with any telecommunications software employed by the user. CORE has designed advanced **graphical user interfaces** for the users of its network GINA (graphical Interface for Network Access.) It will work on different makes of computers and different operating systems such as MSDOS and Macintosh.

Pathways: Access is provided to the Internet.

Internet Connections: Access to the Internet is attained through the transparent CORE link to CSUNet, the backbone service to the California State University system.

Support Services: A cadre of TeleMentors provides support and training through the Telemation Project.

Conversation Structure: Members communicate through electronic mail as well as through conferences organized around areas of interest. A wide variety of Usenet Conferences are also available in the Conferences section of CORE.

Information Retrieval: Users can access library catalogs, public databases, listserv discussion group archives, education-related bulletin boards, and curriculum-based activities.

Organization: The network is organized around a series of CORE Services menus, including moderated and unmoderated group conferences, telnet, Gopher, FTP, e-mail and other basic Internet services.

Costs: The are no charges. GINA (Graphical Interface for Network Access), the sophisticated graphical user software interface for use with the CORE/Internet service is offered for an annual fee of $40.

TENET (Texas Education Network)
Connie Stout, Director of Programs
Texas Education Agency
1701 North Congress Avenue
Austin, TX 78731
512-463-9091

TENET provides e-mail, bulletin boards, conferencing systems, database services, remote log-in, Gopher access, and remote file transfer to educators from kindergarten through grade 12 in Texas. The system supports collaboration among educators at all levels, from kindergarten through postsecondary education.

Participants: They include administrators, teachers, and students from both public and private schools from kindergarten through higher education in Texas.

User Interface: This single-host-based system generates a simple, menu-driven interface that can be accessed with any telecommunications software employed by the user. TENET is designing advanced interfaces for the users of its network. Users have access to telecommunications **shareware** provided by TENET for all user platforms, which means that it will work on different makes of computers and different operating systems such as MSDOS, Apple, and Macintosh.

Pathways: Access is provided to other major networks, among them **AppleLink**, CompuServe, MCI Mail, AT&T Mail, FrEdMail, and FIDOnet.

Internet Connections: Access to the Internet can be attained through

THEnet (Texas Higher Education Research Network).

Support Services: A core of master trainers provides support and training.

Conversation Structure: Members communicate through conferences organized around areas of interest. They also have access to e-mail, Gopher and bulletin boards.

Information Retrieval: Users can access library catalogs, public databases, and curriculum-based activities.

Organization: The network is organized around moderated group conferences. Individuals can use e-mail too.

Costs: The charges are $5 a year for public schools and $25 a year for independent and postsecondary schools.

VA.PEN (Virginia Public Education Network)
Dr. Harold Cothern
Department of Education
P.O. Box 2120
Richmond, VA 23216
804-225-2921

Virginia Public Education Network provides a statewide infrastructure for the electronic transfer of administrative data and instructional materials to teachers and students in all 2,000 of Virginia's public schools. Users access the network through toll-free telephone numbers located throughout the state.

Each host subscribes to the USENET newsgroups (see under the entry for UUNET in Appendix A). Newsgroups with information specific to Virginia education transfer that information to various listservs. VA.PEN also distributes prototype instructional projects for teachers to use with their students. Network facilitators help teachers to use these projects and to create their own.

Participants: Users include teachers, students, administrators, and anyone interested in education for kindergarten through grade 12 throughout the state of Virginia.

User Interface: This single-host-based system generates a simple, menu-driven interface that can be accessed with any telecommunications software. This means that no matter what software is used, the user always sees the same menu.

Pathways: Gateways are provided to other networks all over the nation.

Internet Connections: The Internet can be reached through most servers.

Support Services: Support services are provided through the Virginia Department of Education. Users have access to online documentation and receive a user's manual. Online help will be available.

Conversation Structure: Members communicate through e-mail, bulletin boards, conferences, and listservs.

Information Retrieval: Members can transfer files by using a file transfer protocol (FTP) from sites that have access to the Internet.

Organization: The network is organized around moderated group conferences.

Costs: There is no charge for this network for K-12 users.

Concluding Remarks

In most fields, when new technologies are introduced, it usually takes some time for them to become widely known and used wisely. So it is with computer telecommunications. Little research has been done on the impact of information and computer technologies on the technical, social, and pedagogical aspects of teaching children in the kindergarten through grade 12 age groups. In spite of this, educational projects that incorporate computer telecommunications are being planned, designed, and implemented.

The use of this exciting network technology is both gratifying and troubling. It is exciting to see the technology being used to advance goals rather than to direct them. Educators are creating and participating in linked communities as an integral feature of projects that promote collaboration, encourage students' group activities, expand the information knowledge base, and connect users to the global community. The wide use of telecommunications in education is causing concern, however, among network designers, providers, and supporters. The basis of this concern is the process used to select networks. Often, there has been little guidance for this process. Networks have been selected for a single reason, such as cost, or solely because the planner had used a particular network.

This *Guide* provides the educator with information for selecting and creating a networked community that is linked electronically. With this information, planners will be able to examine systematically the options available and to employ a clearly defined process for selecting an electronic network.

The user of this *Guide* should be sensitive, however, to the consumer caveat--"buyer beware." Although the process described herein is based upon extensive research in the field and the frameworks have been defined carefully, the technology to which the process is to be applied is not static. The network environment is evolving into a new generation of networks. The frameworks of the future tend toward a single structure that will address instruction rather than delivery. This new "instructional framework" will offer a continuous uninterrupted setting in which the services and resources of networks will be delivered.

In the near future, networks will provide access to video, **satellite,** and fiber transmissions, which will be delivered directly to users at home and school on **workstations** that incorporate each of these technologies through new hardware and software. This *Guide* addresses electronic computer networks only, but the selection process described will apply easily to the new networks that will merge the future technologies.

The new instructional framework for selecting a network will be one in which the planner will determine the educational resources required for the project to be successful. These might include access to libraries for print, sound, graphics, and video information; self-paced instructional lessons; sophisticated computers for computation or publishing; collaborative learning environments with video and audio conferencing in real time; experts; and data collection graphics and tools. Whatever is needed will be available through the electronic highway for teachers and students to use.

Furthermore, as pointed out by Hunter (1992), by applying the concept of internetworking to educational innovation, it will become possible for every individual and group involved in educational change and research to be a direct contributor to the collective process of innovation. The expertise, research, instructional materials, goals, lesson plans, computer software, and databases of every project can be contributed to the collective knowledge base of the nation. That same technology, using the Internet, will make it possible eventually for any child, teacher, citizen, or expert to locate, use, or participate in these innovative projects.

In order to take advantage of computer-communications technology in education, it is not necessary to create centralized repositories of materials, data, or software, or a vast homogeneous network of all those involved in education from kindergarten through grade 12. The concept and technology of internetworking can serve as a foundation for the collaboration and coordination of a wide array of disparate efforts by federal, state, and local agencies, including not only educational agencies, but also libraries, public health and human services agencies, and others with missions related to education.

As has often been said, imagine a global classroom in which each student has access to what is needed to learn and grow in the best way possible. This classroom is possible for communities that are linked through electronic networks. The information in this *Guide* is merely the point of departure for the process of growth and exploration.

Appendix A

Additional Networks, Projects, and Examples Referenced in the Guide

This appendix gives a brief overview of those networks, projects, and examples referred to in the guide, but not described in Chapter 4. The list is not exhaustive. Additional information and more examples can be obtained from such sources as EDUCOM, Internet listservs, Educorp Consultants Corporation, CoSN, the National Science Foundation, and Village Associates.

Big Sky Telegraph
Frank Odasz
Western Montana College
710 S. Atlantic Street
Dillon, MT 59725
406-683-7338

Big Sky Telegraph is a grass-roots telecommunications system linking Montana's rural schools with resources and other rural teachers. It offers library services, free searches of the ERIC (Educational Resources Information Center) database, use of copyrighted software through a loan library, and online training classes. Its services are free to those interested in rural education and rural community support. Its users come from across the state of Montana as well as the county and city governments of 15 other states. It has collaborative functions and online courses for college credit.

CoSN Consortium for School Networking
c/o John Clement, Temporary Secretariat
EDUCOM K-12 Networking Project
1112 Sixteenth Street, N.W., Suite 600
Washington, DC 20036
202-872-4200

This is a group of individuals from private organizations, public agencies, education, academia, and universities whose goal is to make available to students and educators a nationwide network of information and communication resources that increase their productivity, professional competence, and opportunities for learning and collaborative work. The group wants to connect a critical mass of users and provide them with access to resources, training, and support. CoSN also promotes collaboration between electronic networks and networked communities and supports educational restructuring. The group advocates a four-step process: accept the interim **National Research and Education Network** as the principal backbone structure for the network, compile a national resource directory containing information about telecommunications in education, provide support for users, and encourage research and development in network applications for curriculum, instruction, and administration.

DIALOG Information Services Inc.
3460 Hillview Avenue
Palo Alto, CA 94304
800-3-DIALOG

DIALOG dispenses information online. It offers sophisticated, low-cost, customized, classroom instruction programs to elementary through graduate school classes. Students can search journals, magazines, dissertations, statistical reports, company profiles, directories, and more. DIALOG offers three specialized instruction programs tailored to specific educational needs. DIALOG Classmate provides access to over 80 databases in the scientific, social science, and medical fields. Curricular support includes a student workbook, a teaching guide, and a video tape. DIALOG CIP provides access to over 300 databases for schools of education, engineering, law, psychology, chemistry, computer science, agriculture, and medicine. It offers a 24-hour customer support line, training, a training video, a laboratory workbook, and a reference manual.

DIALOG Business CIP provides low-cost access to sources of business information like Dun and Bradstreet and Standard and Poor. Usage is restricted to a classroom setting.

Educorp Consultants Corporation
Barbara Kurshan
1414 Third Street, SW
Roanoke, VA 04016
703-345-1429

Educorp is a consulting firm specializing in the areas of telecommunications, multimedia, and educational technology. Projects include research, product design and implementation, evaluation, and market analysis.

ENAN The Educational Native American Network
Center for Technology and Education
University of New Mexico
College of Education
Student Services Center
Room B 87
Albuquerque, NM 87131
505-277-7310

ENAN is a nationwide, bulletin board system, telecommunications network based at the University of New Mexico. It serves teachers, students, and administrators in Bureau of Indian Affairs schools and selected professionals in the field of Native American education. The ENAN system allows participants from around the country to send e-mail, join in conferences, download data from libraries, and engage in collaborative educational activities with other Native Americans.

FIRN
Florida Information Resource Network
Bill Schmid, Director
Room B1-14
325 West Gaines Street
Florida Educational Center Tallahassee, FL 32399
904-487-0911

FIRN has been touted as the most comprehensive communications network in the nation. FIRN links all state universities, community colleges, and public schools in the state of Florida to a communications network. This network serves as the Florida Department of Education's primary data communications facility and it provides connections among all educational agencies. Data communications equipment is located throughout the state at all school districts, community colleges, and state universities. FIRN offers classes and communications through satellite and video transmissions.

➳ **Global Laboratory**
TERC Technical Education Research Centers, Inc.
Robert Tinker
2067 Massachusetts Avenue
Cambridge, MA 02140
617-547-0430

TERC's Global Laboratory project enables teachers, students, and scientists around the world to undertake hands-on scientific investigations of global ecology and human-induced climate change. Low-cost instruments have been developed to assist classes in monitoring local sites, collecting and analyzing data, building and evaluating computer models of global change, and designing further experiments. TERC's international, computer based, telecommunications network provides the forum for sharing data and facilitating collaboration among participants. This project is funded by the National Science Foundation.

➳ **WorldClassroom**
Gary Crary, President
Box 201361
Arlington, TX 76006
214-641-3356

WorldClassroom, a global curriculum and information network for K-12 schools, links classrooms to work together on structured curriculum activities in science, social studies, language arts, and foreign languages. WorldClassroom also provides Guest Speakers, experts from various professions of interest to students and teachers.

The User's Guide provides lesson overviews, lesson plans, teacher's notes, and tips on implementation. There are online moderators for each project and every school is assigned a host/hostess online.

There are online databases for students to use in completing their research and writing assignments. There is also an online newsletter called NewsLink that gives students a chance to write for an international audience.

Learning Link
Robert Spielvogel, Director
Learning Link National Consortium
WNET/Thirteen
356 West 58th Street
New York, NY 10019
212-560-6613

Learning Link is a computer-based, interactive communications system that features a variety of databases and information resources, message centers, mail, and gateways to remote databases and bulletin boards. Its services in 13 states throughout the United States are managed locally and are operated by public broadcasting stations, educational agencies, or community organizations. A national version is available to those who do not have access to the local version. The system is designed for educators and students from kindergarten through grade 12, adult learners, public television viewers, local businesses, and special interest groups. The national consortium provides technical support, databases, and editorial content. Local operators customize the services to meet the needs of the networked community. The system is licensed, developed, and maintained by LinkNet, Inc.

PSInet People Sharing Information Network
Jack Gerlovich
Council of State Science Supervisors
Center for Teacher Education
Drake University
Des Moines, IA 50311
515-271-3912

People Sharing Information Network is a national computer conferencing network for science and mathematics education. IBM provides technical support for the network, which links state science and mathematics supervisors with science and mathematics education agencies. It has intrastate networks in place in nearly 40 states and is exploring access to Internet.

The Council of State Science Supervisors runs a network called CS3 on PSInet, and mathematics and science supervisors in selected states also have formed a networked community using PSInet. This network operates out of Ames, Iowa and plans to link all 50 states.

SuperQuest
Helen Doerr
Cornell Theory Center
Engineering and Theory Center Building
Cornell University
Ithaca, NY 14853
607-254-8699

SuperQuest is a national competition for high school students. Students from three states participate in the program. Projects can be from any discipline as long as supercomputer technology is required to analyze or complete them. A panel of experts from all over the United States analyzes the students' entries to determine a pool of winners.

The winning teams (consisting of three to four students and one to two teachers each) are funded to attend a three-week summer program to learn about supercomputer applications and technology. These teams also win a scientific computer workstation for their schools, which the students use during the school year to complete their winning projects.

TeleApprenticeships
James Levin
210 Education Building
University of Illinois at Urbana-Champaign
1310 South 6th Street
Champaign, IL 61820
217-244-7005

TeleApprenticeships is a model for science and mathematics education on computer-based networks. The TeleApprenticeships methodology involves students, teachers, and private sector partners in the study of scientific and mathematical issues. Students share data electronically and analyze them locally, with the help of local experts.

UUNET Communications Services
3100 Fairview Park Drive, Suite 570
P.O. Box 2324
Falls Church, VA 22042
703-204-8000

UUNET is a subscription network relay service for traffic on the UUCP and USENET networks and for traffic between UUCP and Internet. Physically, UUNET is a single machine. Its most basic function is to transfer mail and news among users on the UUCP and USENET networks in North America. Quick international transfers are provided on another major service. Users do not have personal accounts on the UUNET machine--only UUCP log-in accounts. In general, UUNET originates no information and is, in effect, a **common carrier**.

UUNET provides gateway service to Internet through a connection to the NSFNET midlevel network, SURAnet. Because of its direct connections to many national networks around the world and to Internet, it is capable of relaying mail from its subscribers to almost any network. UUNET technologies provide access to USENET

News, UUCP mail, and UNI source archives. UUNET is one of the most extensive news services in the country, with over 700 sources of news and 1,700 direct-mail connections. It also serves as the principal gateway to European, Australian, Asian, and South American UUCP sites. UUNET is connected to CompuServe and other networks. The system is monitored 24 hours a day, 7 days a week.

UUNET acts as a forwarder for many **domains** that do not have other connections to Internet. It also can register new domains and provide name service.

Village Associates
Marcia Harrington
5949 Village Lane
Roanoke, VA 24019
703-366-2215

Village Associates offers consulting services in the areas of telecommunications and business, such as telecommunications network design and implementation, and network research and analysis. Services to business include strategic planning, market research, and feasibility studies.

Free information for new users:

InterNIC
info@is.internic.net
800-444-4345

A set of three organizations funded in part by the National Science Foundation dedicated to serving the needs of the Internet community. InterNIC specializes in helping new users and in compiling registration, directory and database information. For more information, InterNIC offers hotline assistance at 800-444-4345.

Appendix B

Prospects for Networking in the Schools

In their paper on *Local Infrastructure for School Networking: Current Models and Prospects* (Newman, Bernstein, and Reese, 1992), the authors identify a paradigm shift that must take place in school networking. They find that the ultimate goal is to retool the schools with a local technical infrastructure that gives teachers and students immediate access to communications systems and information resources and thereby supports the implementation of advances in pedagogy and educational technology. On a more immediate level, the authors want to revise what they find to be an overly narrow conception that many educators hold about network technology. They note that, in schools, the talk of "telecommunications" or "telecomputing" refers to the decades-old technology of connecting terminals to **time-sharing** computers. If this concept of networks persists, it will have a stultifying effect as schools attempt to use networks during the 1990s. The current notion of telecomputing cannot address the information requirements locally within the school and, ultimately, will fragment and inhibit any move toward universal access to information resources. A technology is needed that combines local area networks (LANs) and wide area networks (WANs), making access to remote resources part of the everyday work with school computers.

The following observations on the future of school networking are reproduced from the conclusion of the paper.

> How do we move from a situation in which only a minority of schools have even a terminal connection for a single computer in a classroom to a situation in which there is universal access to a national data network such as the National Research and Education Network? We believe the prospects for universal access are very good as long as schools can make use of current and planned investments in local, district, and state education networks. We see the terminal-host paradigm as essentially dead end. If the goal is to make resources available to all teachers and students, the centralized computing paradigm (the basis for the terminal-host connections) cannot handle the task. In this concluding section, we suggest the next steps that must be taken toward a school network with remote network connections.

Build Remote Network Connections

A number of paths might be recommended to get from the upper left cell of the matrix to the lower right cell. One path is the "high road" along the top of the matrix. This path continues the terminal host paradigm. When LANs are acquired, network modems are used to distribute access to the telephone line; when local servers are used, material is **portaged**.

This route has major limitations because the remote and local systems remain essentially independent, requiring the manual portage of the material from one to the other. The transition from the portage to the Internet server requires considerable retooling since software in use locally may not function on the wide area network.

Another path, shown above, is the "low road" along the bottom row of the matrix. In this case, we would begin by migrating from the upper left to the lower left; that is, not assume the initial availability of LANs, but begin developing the expertise and the software to support true network connections in schools with **stand-alone** computers.

This direction may be more workable. With the installation of a LAN and a router, the same software, resources, and style of interaction that is familiar from the single connected computer are simply extended to the other computers. An e-mail client program, for example, that is used on the one networked machine can now be used on any of the machines on the LAN. With the later introduction of a local server, the same network interactions are simply brought closer and offered at a faster speed over the LAN.

This transition path argues for the aggressive migration from terminal connections to remote network connections in education. Some of the software for these connections, which are currently offered as a commercially available service, may require improvement for use by teachers who are new at networking. The migration path is worth developing, however, since it will open up to schools the kind of connection that can support standard forms of software.

Address Security and Management Concerns

The open access that comes with internetworking raises concerns about how to keep administrative records secure and how to monitor students' communication. Much of the existing state and district level network infrastructure (as well as many of the school LANs) supports administrative communication and databases of students' records. The resistance that we have found in discussions of using existing administrative networks for instruction often revolves around fears of students breaking in and compromising those records. Instructional networks in the schools also could be prey to "hackers" intent on destroying or stealing data or planting viruses on school computers. Certainly, such concerns have been addressed in military and business networks and by the Internet community (for example, Holbrook and Reynolds 1991), but school telecomputing has not made use of the level of technology available in other sectors. The design of a national educational network will have to incorporate adequate security mechanisms.

Educators also expressed concerns about managing communication from the school to the outside world or even communication within the school. Occasionally, the worry is that students or teachers will make use of the system for communication unrelated to instruction. For example, students may discuss socially sensitive issues or teachers may conduct union-related business. In business, research, and academic settings, extracurricular communication is seldom controlled. Provocative communication via e-mail is dealt with as it would if expressed in other media. It is not clear that schools should be any different in this respect. There is a difference, however, in the case of communication with the outside world. Even teachers who are deeply committed to empowering students' self expression question the wisdom of allowing unregulated communication by students on national and international networks in terms of both the reputation of the school and the needs of the students for help with clarifying their communication. An advantage of the telecomputing model in which only the teacher has an account on the outside service is that all messages that cross the wire can be monitored. The teacher can work with children, who cannot be expected to know the rules of network discourse, to clean up their communication and can distribute the incoming messages appropriately. While many teachers will feel comfortable giving many students unrestricted access, a communication system for schools, to be acceptable to the majority of teachers and administrators, will have to provide for the possibility of monitoring students' messages.

Develop an Integrated Server

Currently, there is no server on the market appropriate for helping schools and school districts to connect to Internet. A school server should integrate several commonly needed services and provide an adequate system for administering or managing those services. Such a server might be implemented on a relatively inexpensive computer such as a 486 personal computer running a version of the UNIX operating system. Besides database, file, news, and mail services, the server also should provide a standard Internet routing service that allows anybody at a personal computer on the LAN to communicate over the entire Internet.

Most of the network services' software that would be needed is readily available for integration on such a platform. A management system, based on a sophisticated database tool, could integrate the administration of these services and provide the kind of security and management of access privileges required in the school setting. The development of the management system in a way that takes advantage of existing administrative databases for the creation and updating of teacher, student, and other school accounts; that can be maintained easily as a part-time activity in the school; and that allows appropriate distribution of these tasks among coordinators and classroom teachers is perhaps the most critical component of a school server.

Develop Client Software

An important reason for moving quickly toward true network connections is that it will open the way for educational software developers to create network software that will be usable regardless of where in the internetwork the classroom's computer finds itself. To allow the smooth scaling up from a single, stand-alone computer with a modem in a school to the district-wide Internet, the fundamental relationship between the software running on the classroom computer and the software running on the server must be the same, regardless of whether the server is located in the computer laboratory next door or available by dialing the regional network center in another state.

There are near-term prospects for true networked systems coming into the schools as the commercial standards for client server software interfaces are developed and adopted by manufacturers. Such "network-enabled" software, whether a word processor, a database interface, or a simulation, is able to communicate with resources anywhere on the Internet. In this way, a spreadsheet or a simulation can send or receive electronic mail directly, or a **HyperCard stack** can obtain and display data from a remote computer. A major advantage of network connections is the far greater ease of interaction with network services that they afford. Using standard Internet protocols makes it possible to have a completely open and general network-enabling strategy in which all educational software developers can participate.

The network paradigm will not be a lowest common denominator solution to school networking. We do not believe that there is a direct trade-off between the cost of the technology and the ability to provide universal access. The lowest cost, short-term solution, a simple terminal-host system using very-low-speed dial-up lines, will not be able to take advantage of existing and planned investments in district wide networks to lower costs. Nor will it be able to encompass multiple applications to raise the value of the investment. It also is far less likely that easy-to-use client software will develop for the terminal-host paradigm in the way that it is developing already for networks.

The history of school LANs and WANs is different from that in other sectors. It is not simply that schools lag behind. The functions of the technology have been different, resulting in two distinct tracks; in other domains, LANs and WANs evolved together. Schools remain different functionally, organizationally, and in scale from business, research, military, and other environments in which networks have been deployed. Current solutions in these sectors will not necessarily be adequate for schools, but schools can learn from them and borrow technology as needed. It may well be the case that future network solutions for schools will be borrowed by industry as we confront for the first time the issues of scale and ease of use and begin creating organizations in which people can learn through communication.

Appendix C

Glossary*

Access--The ability to send or retrieve information.

Addressing convention(s)--Information on how to address mail and files so that they will reach their destination. Also called **naming convention**.

Anonymous FTP site--See FTP.

AppleLink--A network run by Apple Computer, Inc. for its client users.

Application--A computer program, software, designed to carry out a particular task.

Architecture--The overall design of a network, including the hardware and the protocols.

> **Decision-tree architecture**--A structure that leads one to a decision by guiding the user through specific related topics that narrow the scope of options available.
>
> **Menu-driven architecture**--A design that lists on the screen the functions available on the system. The user selects an item from the list (menu).

* *The reader may find in the glossary some words or phrases not encountered in the text of the* Guide. *They are included because they are basic or standard words or terms used in telecommunications.*

Archives--Stored records, files, documents, etc.

Archie--An Internet utility (developed at McGill University) which offers an electronic directory service for locating information in the Internet. The best known use of Archie is for scanning a database of the contents of more than 1000 anonymous FTP sites around the world. Known as the Archie database, it contains more than 2,100,000 file names from anonymous Internet FTP sites. Using this database, which is accessible by e-mail or Telnet, Internet users can easily find the location of files they need without logging onto several machines. The Archie database is automatically updated, thereby ensuring that the information is accurate.

AT&T Mail--A telecommunication network that transmits voice and data across telephone lines and fiber cable.

BBS--See Bulletin board system.

BPS--Bits per second. The measurement of modern transmission speed. Not comparable to baud after 300 bps.

Backbone--A high-speed connection that links many networks.

Baud--The number of signals sent per second.

Baud rate--The speed at which telecommunications data are transmitted from one computer to another. The rate is measured in bits per second. The most common baud rates are 300, 1200, and 2400.

BITNET--Because It's Time Network. This is an academic computer network based originally on IBM mainframe systems.

Bulletin board(s) or Bulletin board system (BBS)--A computerized system for reading and leaving messages by computer about a specific subject. Sometimes, it is a small-scale, local, electronic network that includes space for the public to leave messages and to comment on what is posted. Some bulletin board systems include space for the storage of data files. Also called message boards.

> **Distributed electronic bulletin board**--Messages that are taken from one network and sent to other networks. Also called distributed electronic posting systems.

Bundled costs--This has two meanings: (1) that the cost of the software is included in the overall price of the computer system; in such a case, the software often cannot be obtained separately; (2) that the costs of several items or services are billed in a lump sum, instead of being itemized individually so that the charge for each item is known.

Chat, chatting--Communicating by computers with another person or persons in real time. Chatting enables several users to send private messages to each other without other members of the network receiving them also.

Closed networked community--Admission to the network is limited to those who meet a specific criterion or criteria.

Closed system--See System.

Clusters--Also called conferences (which see), learning circles, and forums.

Code / source code--The basic programming languages.

Common carrier--The telephone connection made with another computer. A common carrier is a regulated entity, such as AT&T, US Sprint, or MCI, that provides its users with access to communication channels.

Compatibility--The ability of different devices to communicate with each other.

Computer-aided instruction--Instruction that is carried out or supported by computer technology.

Conference(s)--An online, written discussion about a particular topic between two or more individuals. Also called a cluster, a forum, and a learning circle. A teleconference takes place over a long distance. These terms may have different meanings in different contexts.

> **Conferencing system**--Software that facilitates online discussion.
>
> **Moderated conference**--An online conference with a moderator (who functions like a moderator presiding at a live, face-to-face meeting).

Cursor--A movable pointer used on a screen.

Data--The raw material out of which information is formed.

Database--A collection of interrelated and integrated sets of data (files) used by many applications.

> **Electronic network database, or a Project-designed database**--A specialized database typically established for a par-

ticular project or available on a network for a specific activity or use.

Data communications--The active process of transferring data from one point to another.

Dedicated--Set aside for a particular use.

Dedicated computer--A computer whose use is limited to a specific task or set of tasks.

Dial-in--Reached by dialing a telephone number.

Dial-in help--Assistance available by telephone.

Disk / diskette--A medium on which data for a computer are stored; also called a floppy disk or a floppy.

Distributed electronic posting systems / Distributed bulletin boards--See Bulletin board.

Distributed network--See Network.

Domain--The site of a host computer.

Domain name--A unique address name given to a computer by which it receives e-mail.

DOS--Disk Operating System. A common type of operating system for a personal computer.

Download--The process of moving a file from a host to a personal computer.

Echo forum--See Forum.

Electronic mail--Messages sent from one individual or group to another through a computer network. Most electronic mail systems simulate the way that mail is usually handled, with capabilities such as sending mail, reading mail, forwarding mail, copying mail, saving mail, and writing or editing mail. Sending and receiving mail electronically usually requires an identification number and a password to enable access to be made to the mail system.

E-mail--The abbreviation for Electronic mail, which see.

File(s)--A set of associated data with a unique identifying name.

File functions--The access, retrieval, and transfer of files between computers.

File transfer--Using communications software, one computer can be linked to another in order to exchange data files (e.g., word-processed documents) and programs that are in the public domain (e.g., games). When a file is received from an external source, it is downloaded.

File transfer protocol--See FTP.

Remote file transfer--The transfer of a file from a remote host at another site to the user's computer.

Forum--Same as a Conference, which see. Also called a cluster or a learning circle.

Echo forum--The capability to forward comments received during an online, written discussion or conference to people in other conferences and on other networks who did not participate in the discussion.

Freeware--Software that is available to the public, for free. Often accessible through FTP access to many host sites on the Internet. See also Shareware.

FTP--File Transfer Protocol. It is the Internet standard, high-level protocol that allows files and software to be transferred and/or retrieved from another computer attached to a network (such a computer is also called a host, a node, the system, or the network).

Anonymous FTPsite--An Internet host computer that makes certain of its files available to those who log-in as "anonymous," and give their e-mail address as a password. The files usually found at anonymous FTP sites are software packages for various systems, utilities, information, mailing list or usenet group discussion archives. At most FTP sites, the resources are organized hierarchically in directories and subdirectories.

Gateway(s)--A computer that links dissimilar networks and allows information to cross between the two.

Gopher--Also known as The Internet Gopher system, allows users to search and retrieve information residing on many Internet servers in a seamless fashion. Created by team of programmers at the University of Minnesota, it links to other gopher servers to create a Internet-wide cooperation--the global gopher web (Gopherspace). The information appears to the user as a series of nested menus, resembling the organization of a directory with many sub-directories and files. The sub-directories and the files may be located either on the local server site or on remote sites served by other gopher servers. From the user's point of view, all information items presented on the menus appear to come from the same place.

> **Veronica**--Provides keyword indexing and access for menu offerings to different information systems on the Internet. Once appropriate information systems are identified, users may telnet to those systems to query databases and services of interest.
>
> **Jughead**--Provides a way to search Gopher menus for the local site only.

Graphical User Interface (GUI)--A user interface system which allows selection of menu choices by pointing to a picture symbol (icon) which represents the function desired.

Hard copy--Output from a computer that is printed on paper.

Hardware--The computer itself as well as the technology used to acquire, store, and communicate data.

Hierarchical network--See Network.

Hierarchy--The listing of items in their order of importance or precedence by, for example, topic, subtopic, subsubtopic and so on.

Host(s)--The computer on a network, usually a minicomputer or a mainframe computer, that stores information and/or facilities for telecommunications. It is also called a node, a server, the system, or the network. Members access the host (which serves many users) by personal computer, modem, or telephone line.

> **Host server(s)**--See Server.
>
> **Multiple hosts**--Several mainframe computers or several nodes.

HyperCard stack--An icon-driven program for the Macintosh computer built with *HyperCard* software.

Icon--A graphic symbol that represents an activity to be carried out by a computer.

> **Icon-driven**--Getting where one wants to go by putting the cursor on top of the picture of the activity to be performed. The picture is the icon. For example, to send a message, the cursor is moved to the picture of an envelope.

Icon screen--A screen on which function options are displayed as graphic symbols or pictures instead of as text.

Infrastructure--The physical equipment (hardware and software) that enables a network to function.

Input--Information (data) entered into a computer.

Interface--The boundary between the information system and everything outside the system; the link between the resources and the components of a system. Interfaces can be customized by the user, have graphic representations, be adjusted by the hardware, and use hypermedia functions.

User interface--The boundary between the user and the computer, where a human meets a computer at the screen level.

Internet--(The Internet) A world-wide network of networks that serves as an information conduit for the transfer of messages and files.

Knowledge base--A knowledge base is a program or a database that contains data in a multiple format. A knowledge base can be explored randomly, whereas a database must be searched in a specific sequence because it is a structured set of information.

LAN--Local Area Network. A LAN links computers with other computers in close proximity. By connecting computers in a LAN, the users can share devices such as printers and storage disks and the hardware that connects them to networks.

Learning circles--Also called a conference (which see), a cluster, and a forum.

Leased line--A telephone line leased from a common carrier for the exclusive use of the lessee.

Listservs--Also known as Listserv Discussion Groups, distribute e-mail (messages) to members on a specific address list. The identifying names and addresses of people with common interests are grouped on a list, then stored on a computer with listserv software. A single mail message sent to this list (by a member of the list) is distributed automatically to everyone whose address is on the list. (Listserv is actually a trademarked name for a particular software application used for the purpose just described. The term has also come to be used for the format, as well.)

Local area network--See LAN.

Log-in--Same as Log-on, which see.

Log-on / log-off--The process of entering and leaving an electronic communications system.

> **Remote log-on**--To connect to a network other than the original network by using an identifying name and a password. See Telnet.
>
> **Transparent log-on**--The ability to enter one system and get to another one easily.

Lynx--A character-based browser that provides a full-screen interface for UNIX and VMS platforms and is very easy to use.

Mail agents--The technology and protocols that simplify mail functions such as reading, sending, and filing.

Mailing list(s)--A discussion group, possibly moderated, distributed by electronic mail from a central computer maintaining the list of people involved in the discussion. See also--listserv discussion groups.

Mainframe / mainframe computer--A large powerful machine capable of supporting several thousand diverse users and a high volume of information-processing tasks.

MCI / MCI Mail--A telecommunications network that transmits voice and data across telephone lines and fiber cable. MCI provides access to its mail service, MCI Mail.

Menus--A list of the choices that are available to the user of a software program. The list of choices appears on the screen and programs are run by selecting a topic from the list.

> **Menu-driven**--The functions available on a system are listed on the screen, and the user selects a function from the list (menu).
>
> **Structured menu**--A menu that leads the user to one or more subsequent menus.

Message(s)--A specific piece of information. The data that travel between the source and the destination. In a computer network, the data sent for processing or for sharing with a computer at another site.

> **Message board**--The area on a network where messages are

posted or stored on the system for reference. Same as a bulletin board.

Messaging--A process in which information is sent to a distant computer and stored there electronically until the receiver calls in to read it. Private messages are called electronic mail or e-mail. Public messages are called bulletins.

Microcomputer--The smallest computer in size, but not necessarily the least powerful. Also called a **personal computer**.

Minicomputer--A computer intended to be smaller, slower, and less costly while retaining the multiuser and general purpose capabilities of a mainframe computer (but normally larger than a **microcomputer**).

Modem--An acronym for **mo**dulator/**dem**odulator. This is the hardware that allows a computer to transmit and/or receive data over telephone lines. A modem converts computer **signals** to telephone signals and the reverse. The modem can be inside or outside the computer.

Moderated conference(s)--See Conference.

Mosaic--An internet resource locator and navigator developed in 1993 by The University of Illinois National Center for Supercomputing. This software supports easy and transparent access to documents, graphics and other diverse protocols and data formats which are found on the network. It capitalizes on the World Wide Web (WWW) product which enables the using of hypertext links to jump to different information on the Internet.

MSDOS--Microsoft Disk Operating System.

Multiple hosts--See Host.

Naming convention--Same as Addressing convention, which see.

National Research and Education Network (NREN)--A component of the High Performance Computing Act, approved by Congress in 1991. NREN is a five-year project intended to create a national electronic "superhighway." The NREN will be 50 times faster than the fastest available networks (as of early 1992). Proponents of the NREN claim that it will be possible to transfer the equivalent of the entire text of the Encyclopedia Britannica in one second.

Network--A communications system designed to convey information from a point of origin to a point of destination within the network.

It is the physical connection of two or more computers through telephone lines or cables so that users can exchange information. There are two kinds of networks: local area networks (LANs) and wide area networks (WANs). A host, a node, and a server can all be parts of a network.

> **Distributed network(s)**--A network composed of other networks.
>
> **Hierarchical network**--A communication network organized in a tree-like structure similar to a company's organization chart. Communication up and down the nodes (points in the network where data can be sent, received, and processed) goes up and down the hierarchy.
>
> **Network utilities**--See Utilities.
>
> **Project-based network**--A network organized around the accomplishment of a specific task or tasks.

Newsgroup(s)--An electronic conference that allows participants to hold a continuing discussion over a period of time. While an e-mail message can be read only by the recipient, an article or e-mail message posted on a newsgroup can be read by many people. There are more than 1,000 national newsgroups. The network that distributes newsgroups is a subnetwork of Internet called USENET (see more information under UUNET in Appendix A).

Node--The beginning, intersection, or end of a communications link; or the device located at any of these points from which data can be sent, received, and/or processed. Also called a host, a **server**, the system, or the network.

NSFNET--The National Science Foundation Network. It consists of a backbone and several regional networks. It is a group of interconnected, high-speed, **hierarchical networks**. NSFNET midlevel (regional) networks provide connections for regions in the United States. These regional networks also connect to Internet.

Off-line--Refers to performing an operation with a computer while it is not connected to a telecommunications network.

Online--Refers to using a computer while it is connected to another computer.

Online courses--Lessons available by computer for students to learn at their convenience.

Online documentation--A version of the written description of a system or software package that is available through the "Help" function on a computer.

Online help--Help available through a host or software, usually available while one is online or using the software.

Open--

Open networked community--Admission to the network is available to all.

Open system--In this context, the same as an Open networked community, which see.

Operating system--See System.

Operating system compatibility--See System.

Output--The products, services, or other effects produced by a system. The communication of the results of processing in a format understandable to the person using that information.

PPP--Point-to-Point Protocol. A protocol used to allow users to dial into the Internet (i.e. TCP/IP based network) with a high speed modem over a standard telephone line. PPP is a new standard replacing SLIP (serial line interface protocol) although PPP is less common but increasing in popularity. See also SLIP.

Packet--A block of data containing both a message (or part of a long message) and addressing information.

Password--A personal code used to identify the legitimate users of a multiuser system. It is normally used in conjunction with an individual identification number.

Pathway--The series of routes that a message takes through a network in order to get from its origin to its destination.

Peripheral devices--Machines or devices, such as printers or modems, that can be attached to a computer to enable certain functions to be performed.

Personal computer--Same as a Microcomputer, which see.

Platform--A layer of technology upon which other layers can be implemented. Usually, this refers to the hardware and software through which a user is operating.

Point-to-point connection--Joining two, and only two, adjacent workstations, without passing through an intermediary workstation.

Port--A connection to the data receiving and transmitting abilities of a system. The part of the computer that allows it to communicate with peripheral devices.

Portability / portage / to portage--The capability to move, and the action of moving, code from one system to another.

Processing--The activities by which input are transformed into outputs.

Program--A series of detailed instructions that must be carried out by a computer in order to solve a problem, written in language understandable to the computer. (Also called an application.)

Protocol(s)--The rules established by a computer system to transmit data. The protocol must be the same for both the sending and the receiving computers to be able to exchange messages. Examples include SLIP (Serial Line Internet Protocol commonly used for point-to-point connections running TCP/IP--Transmission Control Protocol/Internet Protocol, the application and transport protocols), SMTP (Simple Mail Transfer Protocol--the Internet standard protocol for e-mail), TCP/IP, FTP (File Transfer Protocol), TELNET (Internet's standard protocol that permits remote log-on--connection to a remote terminal), and UDP (User Datagram Protocol), that run over the Internet protocol.

Real time--Communication between two or more people that occurs while they are online simultaneously.

Remote file transfer--See File.

Remote log-in--See Log-on.

ROM--Read-only Memory. A type of semiconductor chip in which underlying instructions to the computer are embedded permanently. These instructions can be accessed and used, but they cannot be changed by the user.

Route--The path that traffic takes on a network, from its source to its destination.

Router--**A dedicated computer** (or other device) that sends packets (units of data) from one place to another, paying attention to the current state of the network.

Routing hierarchy--The pathways and order (hierarchy) in which packets are distributed, determined by the router.

Satellite transmission--A special type of microwave transmission that is used for longer distances, such as across a country, and when line-of-sight transmission is not possible. The message is transmitted from the source to a communications satellite in a geosynchronous orbit and then down to the destination.

Server--A workstation that performs a service to other workstations on a network, such as a computer that shares its printer with other computers on the network. Also called a host, a node, the system, and the network.

Host server--The same as server, which see.

Terminal server--A small, specialized, networked computer that connects many terminals to a local area network through one network connection. Any user on the network can then connect to various network hosts.

Shared text--See Text.

Shareware--Software available to the public at a nominal fee. This type of software is frequently available on bulletin boards and Internet FTP hosts for downloading. The person downloading the shareware application is then free to try it out, and is encouraged to send in payment if kept and used thereafter.

Signal--The physical form of a message.

SLIP--Serial Line Interface Protocol. A protocol that allows computer users at home to dial into a local Internet node with full Internet capabilities (e.g. telnet, FTP, e-mail). SLIP is being superseded by PPP but is still very common. See also Point-to-Point Protocol.

Software--A program or set of instructions that tells a computer how to accept and manipulate data in order to turn it into information; also called computer program or an application.

Source code--See Code.

SprintNet--A telecommunications network that sends voice and data across telephone lines and fiber cable. SprintNet provides access to its mail service, SprintMail.

Standards--Constraints imposed by current technology. Rules governing the types of computers and software that can be used.

Stand-alone--Systems that can function on their own without needing additional computers.

Structured menu--See Menu.

Supercomputer--A very large mainframe computer whose primary activity is carrying out sophisticated and complex calculations.

System--A collection of resources that work together to achieve a goal. Also called a host, a node, a server, and the network.

Closed system--See Closed networked community.

Open system--See Open.

Operating system--The software program that controls the overall operation of a computer.

Operating system compatibility--The software on the host system is compatible with the software on another system.

System operator (SYSOP)--The person who manages the software and hardware used in a telecommunications system. Such a person would manage a bulletin board, a conference, or an interest group.

Time-sharing system--An operating system that creates a multi-programming environment by interrupting the execution of a job after a prespecified amount of time has been used.

Telecommunications--Communications among computers across distances by the use of radio, television, telephone, telegraph, and computer networks.

Teleconference--A conference that takes place over a long distance.

Telenet--A carrier for SprintNet. (Not to be confused with telnet.)

TELNET--The Internet standard protocol that allows connection to a remote terminal (an operation referred to as "remote log-in"). In action, it means to connect across Internet from one computer on a network to another computer on another network. (This term is also used as a verb, as in "to telnet" to another host computer.)

Terminal--A combination of a display screen and a keyboard for putting data into a computer and viewing the results of processing it.

Terminal server--See Server.

Text--Any communication which is written or printed.

Shared text--The ability to share documents on a computer.

Text-driven--A term used to differentiate interfaces. Menus can be text-driven or icon-driven.

Time-sharing system--See System.

Transaction--A business event such as a bank deposit or a credit-card charge, or an exchange of information between two computers.

Transparent log-on--See Log-on.

Tutorial--An online lesson or course of instruction.

Upload--To transmit information created or stored on one computer to another computer (i.e., from a personal computer to a network host computer).

User(s)--The person who is served by the information system.

User interface--See Interface.

Utilities / Utility program--A program used for housekeeping functions such as providing a sorted list of files on a disk.

Network utilities--Programs that handle routine procedures like troubleshooting.

Veronica--See Gopher.

Videotext--A form of multimedia involving the simultaneous presentation of video and text on the same screen.

Virtual--A word used to indicate a seeming or apparent function or condition that appears to resemble the function but is actually different from it, as in virtual network.

WAIS--Wide Area Information Servers. An Internet software protocol that allows users to search and access different types of information on many different computer systems from a single interface. The interface is termed a WAIS client. This text-based information retrieval system provides interactive access to a vast quantity and wide variety of information. WAIS can select databases from an unlimited pool, without the user needing to be familiar with the internal configurations of each database, and it helps to organize responses on the user's machine despite vast amounts of accumulated data.

WAN--Wide Area Network. A network that connects parts of an organization that are spread across a wide geographical area, such as a company with offices throughout the United States, a multi-campus university system, or state-wide K-12 computer network.

Wide area network--See WAN.

Window / Window Screens--A partition of the computer screen that enables a user to work with more than one process at the same time.

Workstation--A networked personal computing device (sometimes called a microcomputer) with more power than a standard personal computer. Typically, a workstation has an operating system that is capable of doing several tasks at the same time.

WWW--A system developed in 1992 by European Laboratory for Particle Physics, CERN, in Geneva Switzerland as a network tool which would link full text documents marked up with HyperText Markup Language. WWW documents can contain links to other text, images, sounds and movies.

X.500--An International Standards Organization standard for providing global directory services. The directory furnishes addressing and communications information to network users and to computer applications.

Appendix D

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